UPSSSC 2026

UTTAR PRADESH SUBORDINATE SERVICES SELECTION COMMISSION

FORENSIC SCIENCE LABORATORY Mains Exam

Part - I

Forensic Science

CHAPTERWISE MCQ BANK

NODIA

Nodia

Scan QR for Demo PDF

GET ALL STUDY MATERIAL IN ONE APP!

- Textbooks
- Previous Year Chapterwise Question Banks
- 30 Sets Sample Papers
- Worksheets

FREE!

DOWNLOAD NOW!

SCAN & DOWNLOAD

GET IT ON Google Play

UPSSSC 2026

UTTAR PRADESH SUBORDINATE SERVICES SELECTION COMMISSION

FORENSIC SCIENCE LABORATORY

Mains Exam

PART - I
FORENSIC SCIENCE

Chapter-Wise MCQ Bank
As Per the Latest Syllabus

Nodia

Downloaded from www.pdf.tube

UPSSSC Forensic Science Laboratory Mains Exam
Part - I : Forensic Science
Edition: August 2026
Published by :Nodia
An Imprint of NODIA EDITIONS LLP

Information contained in this book has been obtained by author, from sources believes to be reliable. However, neither Nodia nor its author guarantee the accuracy or completeness of any information herein and Nodia nor its author shall be responsible for any error, omissions, or damages arising out of use of this information. This book is published with the understanding that Nodia and its author are supplying information but are not attempting to render engineering or other professional services.

© NODIA EDITIONS LLP

MRP ₹730.00

NODIA

NODIA EDITIONS LLP
125, Sector 6, Vidyadhar Nagar, Jaipur 302039
Phone :+91 9001005245
email : mail@nodia.in

CONTENTS

CHAP : 01	Introduction to Forensic Science	5
CHAP : 02	Branches of Forensic Science and Role of Forensic Science Laboratories	26
CHAP : 03	Ethics, Quality Assurance and Standards of Admissibility	46
CHAP : 04	Crime Scene Management and Types of Crime Scenes	67
CHAP : 05	Securing, Protecting and Searching the Crime Scene	89
CHAP : 06	Documentation of the Crime Scene	111
CHAP : 07	Collectio, Preservation, Packaging and Chain of Custody	132
CHAP : 08	Crime Scene Reconstruction	154
CHAP : 09	Types of Evidence: An Overview	176
CHAP : 10	Fingerprints: Types, Classification and Development Methods	198
CHAP : 11	Hair, Fiber, Glass, Paint and Soil Analysis	218
CHAP : 12	Blood and Body Fluid Identification and Serology	239
CHAP : 13	Basics of DNA Profiling	260
CHAP : 14	Human Anatomy Basics	280
CHAP : 15	Blood Grouping Systems	300
CHAP : 16	DNA Extraction and PCR Basics	320
CHAP : 17	Poison Classification and Toxicological Analysis	343

Click Here to Buy book on Amazon

CHAP : 18	Drug Abuse, Narcotics and Alcohol Analysis	364
CHAP : 19	Acids, Bases and Salts	384
CHAP : 20	Basics of Organic and Inorganic Chemistry	404
CHAP : 21	Explosives, Petroleum Products and Arson Investigation	424
CHAP : 22	Chromatography: TLC, HPLC and GC	445
CHAP : 23	Spectroscopy: UV, IR and Mass Spectroscopy	465
CHAP : 24	Handwriting Examination and Signature Analysis	487
CHAP : 25	Forgery Detection, Ink and Paper Examination	507
CHAP : 26	Counterfeit Currency Detection	528
CHAP : 27	Firearms and Ammunition	548
CHAP : 28	Internal, External and Terminal Ballistics	569
CHAP : 29	Gunshot Residue and Trajectory Analysis	589
CHAP : 30	Tool Marks Examination	611
CHAP : 31	Basics of Computers, Networks and Cyber Crimes	632
CHAP : 32	Digital Evidence, File Systems and Data Recovery	654
CHAP : 33	Mobile Email And Internet Forensics	675
CHAP : 34	Basics Of The Information Technology Act	696

NODIA

****

CHAPTER 01
Introduction to Forensic Science

1. The word 'forensic' is derived from the Latin word 'forensis'. What is the original meaning of this term?
(A) Related to science and law
(B) Pertaining to the investigation of crime
(C) The study of human remains
(D) Of or before the forum

2. Which of the following best defines 'Criminalistics' within the broader field of forensic science?
(A) The sociological study of criminal behaviour and its causes
(B) The legal process of cross-examining an expert witness in court
(C) The application of physical and natural sciences to analyze physical evidence
(D) The psychological profiling of serial offenders

3. Match the pioneers of forensic science in List I with their primary field of contribution in List II.
List I: Pioneers
P. Mathieu Orfila
Q. Alphonse Bertillon
R. Francis Galton
S. Hans Gross
List II: Field of Contribution
1. Classification of fingerprints
2. Forensic toxicology
3. System of Anthropometry
4. Foundation of criminalistics
(A) P-3, Q-2, R-4, S-1
(B) P-2, Q-3, R-1, S-4
(C) P-2, Q-1, R-3, S-4
(D) P-4, Q-3, R-1, S-2

4. Which foundational concept dictates that whenever a criminal interacts with a victim or a crime scene, a mutual exchange of matter occurs?
(A) Principle of Material Individuality
(B) Principle of Physical Comparison
(C) Law of Progressive Change in Matter
(D) Locard's Exchange Principle

5. The ancient Chinese text 'Hsi Duan Yu' (The Washing Away of Wrongs), written in 1248 by Song Ci, is considered a historical milestone because it contains the first recorded use of which field to solve a crime?
(A) Forensic medicine and entomology
(B) Systematized fingerprint classification
(C) Modern forensic ballistics analysis
(D) Systematic chemical toxicology

6. Read the Assertion (A) and Reason (R) below and select the correct option.
Assertion (A): Microscopic wear and tear on factory-made shoe soles allow forensic experts to link a specific shoe to a footprint at a crime scene.
Reason (R): The Principle of Individuality states that no two objects in the universe, natural or artificial, are completely identical in all respects.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

7. The first Chemical Examiner's Laboratory in India was established to conduct toxicological analysis in which year and city?
(A) 1849, Madras
(B) 1876, Agra
(C) 1892, Calcutta
(D) 1897, Bombay

8. Which of the following is NOT recognized as a foundational principle or law of forensic science?
(A) Principle of Comparison
(B) Principle of Probability
(C) Law of Progressive Change
(D) Law of Absolute Certainty

9. Consider the following statements regarding forensic science as an applied science:
I. It applies principles from pure sciences like physics, chemistry, and biology to solve legal disputes.
II. It is strictly limited to investigating homicides and ignores civil law matters.

Downloaded from www.pdf.tube

III. It involves the integration of scientific theory with practical field and laboratory techniques.

Which combination of statements is correct?
(A) I and II
(B) I and III
(C) II and III
(D) I, II, and III

10. Arrange the following milestones in the history of Indian forensic science in their correct chronological order, from earliest to latest.
1. Establishment of the Anthropometric Bureau in Calcutta
2. Establishment of the First Chemical Examiner's Laboratory in Madras
3. Establishment of the world's first Fingerprint Bureau in Calcutta
4. Establishment of the first Central Forensic Science Laboratory (CFSL) in Calcutta

(A) 2, 1, 3, 4
(B) 1, 2, 3, 4
(C) 2, 3, 1, 4
(D) 1, 3, 2, 4

11. To identify a suspect's shoe from a footprint left at a crime scene, the examiner must make a test print from the suspect's shoe for evaluation. Which principle of forensic science makes this requirement mandatory?
(A) Principle of Analysis
(B) Principle of Circumstantial Facts
(C) Locard's Exchange Principle
(D) Principle of Comparison

12. What is the primary aim and objective of applying forensic science in the criminal justice system?
(A) To provide objective scientific facts to assist courts in justice
(B) To usurp and permanently replace the primary investigative authority of police forces
(C) To ensure every identified suspect is convicted regardless of circumstantial evidence
(D) To provide direct legal representation and advocacy to victims of violent crimes

13. Which of the following early forensic institutions was established in Calcutta in 1897, marking a global first in the history of criminalistics?
(A) The world's first DNA Profiling Laboratory
(B) The world's first Fingerprint Bureau
(C) The world's first Forensic Ballistics Database
(D) The world's first Questioned Document Bureau

14. Consider the following statements regarding the ancient Indian text, Kautilya's Arthashastra, in the context of forensic history:
I. It outlines procedures for the investigation of sudden and unnatural deaths.
II. It mentions tests for identifying poison in food by observing its effect on animals and insects.
III. It designated investigating magistrates or officers known as 'Pradeshta'.
IV. It strictly prohibited the examination of deceased bodies.

Which combination of statements is correct?
(A) I, III, and IV
(B) I, II, and III
(C) II, III, and IV
(D) I, II, and IV

NODIA

15. The world's first functional police crime laboratory was established in 1910 in a police department attic in Lyon, France, by which pioneer?
(A) Edmond Locard
(B) Hans Gross
(C) Alphonse Bertillon
(D) Mathieu Orfila

16. Read the Assertion (A) and Reason (R) below and select the correct option.
Assertion (A): Biological evidence such as blood or semen must be collected and preserved quickly before it degrades due to environmental exposure.
Reason (R): The Law of Progressive Change dictates that everything in the universe alters with the passage of time.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

17. In a hit-and-run accident, a forensic scientist finds microscopic paint chips on the victim's clothing that match the suspect's vehicle, and a fragment of the victim's clothing caught on the vehicle's bumper. This is a classic demonstration of:
(A) Principle of Chemical Analysis
(B) Law of Progressive Physical Change

(C) Principle of Statistical Probability
(D) Locard's Principle of Exchange

18. Under the Indian legal framework, which section of the Bharatiya Sakshya Adhiniyam deals with the admissibility of expert opinions, including those of forensic scientists?
(A) Section 25
(B) Section 33
(C) Section 39
(D) Section 54

19. Match the following forensic science pioneers in List I with their key innovations in List II.
List I: Pioneers
P. Calvin Goddard
Q. Albert S. Osborn
R. Leone Lattes
S. Alec Jeffreys
List II: Key Innovations
1. Author of "Questioned Documents"
2. Developed the first DNA fingerprinting method
3. Developed an antibody test for dried bloodstains
4. Refined the comparison microscope for ballistics
(A) P-1, Q-4, R-2, S-3
(B) P-4, Q-1, R-3, S-2
(C) P-4, Q-3, R-1, S-2
(D) P-3, Q-1, R-4, S-2

20. Select the correct chronological sequence of major forensic biology discoveries, from earliest to latest.
(A) Discovery of the ABO blood group system → Discovery of a method to group dried bloodstains → Invention of DNA fingerprinting
(B) Discovery of a method to group dried bloodstains → Discovery of the ABO blood group system → Invention of DNA fingerprinting
(C) Invention of DNA fingerprinting → Discovery of the ABO blood group system → Discovery of a method to group dried bloodstains
(D) Discovery of the ABO blood group system → Invention of DNA fingerprinting → Discovery of a method to group dried bloodstains

21. Which historical Indian text is frequently cited by forensic historians for its detailed instructions on how to examine corpses for signs of poisoning, strangulation, and hanging?
(A) Kautilya's Arthashastra
(B) The Charaka Samhita treatise
(C) The ancient Manusmriti legal code
(D) The Sushruta Samhita medical text

22. Consider the following statements:
Statement I: Alphonse Bertillon developed anthropometry, a systematic procedure for personal identification based on a series of body measurements.
Statement II: Anthropometry remained the primary global method of criminal identification well into the late 20th century, completely delaying the adoption of fingerprints.
Choose the correct option:
(A) Both Statement I and Statement II are correct.
(B) Both Statement I and Statement II are incorrect.
(C) Statement I is correct but Statement II is incorrect.
(D) Statement I is incorrect but Statement II is correct.

23. Karl Landsteiner's contribution was fundamental to the birth of forensic serology. What was his breakthrough discovery in 1900?
(A) The ABO human blood group system
(B) The double-helix structure of DNA
(C) The chemical precipitin test for identifying human blood
(D) The luminol test for invisible bloodstains

24. Which foundational principle states that all forensic identifications, whether conscious or unconscious, are based on mathematical likelihood rather than absolute certainty?
(A) Principle of Individuality
(B) Principle of Circumstantial Facts
(C) Principle of Analysis
(D) Principle of Probability

25. Consider the following statements regarding the role and functions of a forensic scientist:
I. Examining physical evidence using scientific protocols in a controlled laboratory environment.
II. Preparing analytical reports and presenting expert testimony in a court of law.
III. Arresting suspects and executing search warrants based on laboratory findings.
Which combination of statements accurately

Click Here to Buy book on Flipkart

describes their role?
(A) II and III
(B) I and II
(C) I and III
(D) I, II, and III

26. Which of the following is the most accurate distinction between Criminology and Criminalistics?
(A) Criminology focuses exclusively on the physical analysis of evidence, whereas Criminalistics focuses entirely on formal courtroom procedures and trial tactics.
(B) Criminology is strictly restricted to studying historical trends in crime, whereas Criminalistics deals exclusively with modern cybercrimes and digital evidence.
(C) Criminology studies the social causes of crime, whereas Criminalistics applies natural sciences to examine physical evidence.
(D) There is no legal or scientific distinction between the two; both terms refer to the exact same field of physical evidence examination and crime scene processing.

27. Read the Assertion (A) and Reason (R) below and select the correct option.
Assertion (A): Forensic science heavily relies on the Principle of Circumstantial Facts, often giving greater weight to physical evidence than to eyewitness testimony.
Reason (R): While witnesses may be biased, coerced, or simply forgetful, physical facts cannot intentionally perjure themselves.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

28. In 1984, working at the University of Leicester, which scientist revolutionized forensic biology by developing the first method of DNA profiling?
(A) Alec Jeffreys
(B) Francis Crick
(C) James Watson
(D) Kary Mullis

29. Match the forensic principles in List I with their practical applications in List II.
List I: Forensic Principles
P. Principle of Analysis
Q. Locard's Principle of Exchange
R. Law of Progressive Change
S. Principle of Circumstantial Facts
List II: Practical Applications
1. Prompt photography of a transient tyre mark before it rains
2. Physical evidence contradicts a suspect's alibi
3. Ensuring proper sampling and preventing contamination during tests
4. Collecting trace fibers transferred from a victim to a suspect
(A) P-4, Q-3, R-2, S-1
(B) P-3, Q-4, R-1, S-2
(C) P-3, Q-1, R-4, S-2
(D) P-1, Q-2, R-3, S-4

30. The Anthropometric Bureau, which utilized Bertillon's measurement system for criminal identification, was established in 1892 in which Indian city?
(A) Bombay
(B) Calcutta
(C) Madras
(D) New Delhi

31. The ancient document 'Hsi Duan Yu' details a case where a murderer was identified because blowflies were exclusively attracted to traces of blood on his sickle. Who authored this text?
(A) Song Ci
(B) Sun Tzu
(C) Confucius
(D) Shen Kuo

32. Which principle emphasizes that the quality and accuracy of a forensic laboratory result is entirely dependent on correct sampling and correct testing methodology?
(A) Principle of Individuality
(B) Principle of Probability
(C) Principle of Analysis
(D) Law of Progressive Change

33. Forensic science is a powerful tool but has practical limitations. Which of the following is NOT a recognized limitation of forensic science?
(A) Contamination or improper collection of evidence can render laboratory analysis useless.
(B) Biological evidence degrades over time and may become unsuitable for analysis.
(C) A lack of adequate exemplar or standard reference samples can prevent conclusive comparisons.

Downloaded from www.pdf.tube

(D) It routinely predicts the specific dates and times a suspect will commit future offenses.

34. Consider the following statements regarding the establishment of the world's first Fingerprint Bureau:
I. It was established in Calcutta.
II. It was officially founded in the year 1897.
III. Indian police officers Azizul Haque and Hem Chandra Bose made major contributions to the classification system used there.
IV. The bureau was established primarily to monitor international cybercrimes.
Which combination of statements is correct?
(A) II, III, and IV
(B) I, III, and IV
(C) I, II, and III
(D) I, II, and IV

35. Arrange the publication or introduction of the following key forensic advancements in correct chronological order.
1. Albert S. Osborn publishes "Questioned Documents"
2. Hans Gross publishes his handbook on "Criminal Investigation"
3. Mathieu Orfila publishes his treatise on poisons
4. Alec Jeffreys discovers DNA fingerprinting
(A) 3, 2, 1, 4
(B) 2, 3, 1, 4
(C) 3, 1, 2, 4
(D) 1, 3, 2, 4

36. Often considered the father of modern forensic toxicology, which scientist published the first major treatise on the detection of poisons and their effects on animals in 1814?
(A) Leone Lattes
(B) Karl Landsteiner
(C) Calvin Goddard
(D) Mathieu Orfila

37. Which of the following statements best describes the interdisciplinary nature of forensic science?
(A) It synthesizes principles from chemistry, biology, physics, and mathematics to analyze legal evidence.
(B) It relies entirely on a single isolated branch of natural science, typically inorganic chemistry, to answer all legal questions before a court.
(C) It is a purely legal and procedural discipline that does not require any background knowledge of basic laboratory sciences or scientific protocols.
(D) It functions completely independently of the traditional scientific method, relying instead on judicial intuition and personal investigator opinion.

38. Read the Assertion (A) and Reason (R) below and select the correct option.
Assertion (A): When a burglar breaks a window, microscopic glass fragments will invariably adhere to their clothing, even if brushed off.
Reason (R): Edmond Locard's Exchange Principle states that whenever two distinct entities come into contact, there is a mutual exchange of matter.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

39. An Austrian prosecutor coined the term 'Criminalistics' and emphasized the need for investigators to use scientific disciplines. He authored the seminal book "Handbuch für Untersuchungsrichter" (Criminal Investigation). What was his name?
(A) Hans Gross
(B) Edmond Locard
(C) Alphonse Bertillon
(D) Francis Galton

NODIA

40. Consider the following statements regarding the Principle of Comparison in forensic science:
I. It dictates that only 'like' items can be compared (e.g., a questioned bullet to a test-fired bullet).
II. It allows an examiner to conclusively match a fingerprint ridge pattern to the tread design of a tire.
III. It requires a known reference standard to be available for comparison with the questioned evidence.
Which combination of statements is correct?
(A) I and II
(B) II and III
(C) I, II, and III
(D) I and III

41. Consider the following statements:
Statement I: The Principle of Analysis asserts that even the most highly sophisticated

laboratory instrumentation cannot overcome the errors of improper evidence sampling and collection.
Statement II: The correct packaging and preservation of evidence at the scene is critical to maintaining the integrity required by the Principle of Analysis.
Choose the correct option:
(A) Both Statement I and Statement II are correct.
(B) Both Statement I and Statement II are incorrect.
(C) Statement I is correct but Statement II is incorrect.
(D) Statement I is incorrect but Statement II is correct.

42. In the history of Indian forensics, the first official laboratory dedicated to scientific criminal investigation was established in 1849. What was this institution called?
(A) Central Forensic Science Laboratory
(B) Imperial Serologist's Department
(C) Chemical Examiner's Laboratory
(D) National Fingerprint Registry

43. Match the specific scenario in List I to the forensic principle it violates or exemplifies in List II.
List I: Scenario
P. A delayed autopsy results in severe putrefaction, making time-of-death estimation difficult.
Q. An officer handles a bloody knife without gloves, depositing their own DNA.
R. Using mathematical statistics to determine the rarity of a DNA profile.
S. Comparing a questioned handwriting sample to a standard exemplar.
List II: Forensic Principle
1. Principle of Probability
2. Principle of Comparison
3. Locard's Principle of Exchange
4. Law of Progressive Change
(A) P-3, Q-4, R-2, S-1
(B) P-4, Q-1, R-3, S-2
(C) P-2, Q-3, R-1, S-4
(D) P-4, Q-3, R-1, S-2

44. The term "forensic" derives from the public squares in ancient Rome where legal trials and public debates took place. What were these squares called?
(A) Forum
(B) Colosseum
(C) Senate
(D) Pantheon

45. Forensic science integrates knowledge from various scientific disciplines. Which of the following is NOT generally considered a core scientific discipline contributing to forensic analysis?
(A) Analytical Applied Chemistry
(B) Theoretical Astrology
(C) Molecular Biology and Genetics
(D) Classical and Applied Physics

46. In 1915, an Italian researcher developed a straightforward method to determine the ABO blood group of dried bloodstains, highly relevant for criminal investigations. Who was he?
(A) Karl Landsteiner
(B) Leone Lattes
(C) Albert S. Osborn
(D) Hans Gross

47. Select the correct logical sequence of the fundamental steps involved in forensic science investigation from crime scene to court.
(A) Laboratory Analysis → Recognition of Evidence → Court Testimony → Collection of Evidence
(B) Recognition of Evidence → Collection and Preservation → Laboratory Analysis → Court Testimony
(C) Court Testimony → Laboratory Analysis → Collection and Preservation → Recognition of Evidence
(D) Collection and Preservation → Laboratory Analysis → Court Testimony → Recognition of Evidence

48. From the perspective of the justice system, which of the following is the most accurate description of the ultimate objective of a forensic scientist?
(A) To generate biased physical evidence that strictly guarantees the prosecution wins every court case
(B) To independently interrogate criminal suspects using investigative techniques to extract written confessions
(C) To present objective scientific facts to the court to determine truth
(D) To actively ensure that all traditional eyewitness testimony is completely excluded from judicial proceedings

Click Here to Buy book on Amazon

49. Consider the following statements regarding the contributions of Colonel Calvin Goddard:
I. He is widely recognized as the father of modern forensic ballistics.
II. He adapted and utilized the comparison microscope for the examination of fired bullets and cartridge cases.
III. He authored the first comprehensive classification system for human fingerprints.
IV. His work helped establish the first independent forensic science laboratory in the United States.
Which combination of statements is correct?
(A) I, II, and III
(B) II, III, and IV
(C) I, III, and IV
(D) I, II, and IV

50. The foundational text "Questioned Documents", first published in 1910 and still considered a primary reference in handwriting examination, was written by:
(A) Colonel Calvin Goddard
(B) Sir Francis Galton
(C) Albert S. Osborn
(D) Dr. Hans Gross

51. The observation that the friction ridge patterns on human fingers are unique to each individual, even identical twins, is a practical application of which forensic principle?
(A) Principle of Progressive Change
(B) Principle of Individuality
(C) Principle of Analysis
(D) Principle of Circumstantial Facts

52. In India, the Directorate of Forensic Science Services (DFSS) is a nodal agency that operates Central Forensic Science Laboratories (CFSLs). Under which Union Ministry does the DFSS operate?
(A) Ministry of Science and Technology
(B) Ministry of Law and Justice
(C) Ministry of Defence
(D) Ministry of Home Affairs

53. Prior to the widespread adoption of fingerprints, what was the primary systematic method used by police forces globally for identifying repeat offenders, introduced by Alphonse Bertillon?
(A) Anthropometry (body measurements)
(B) Retinal scanning and ocular imaging
(C) Spectrographic voiceprint analysis
(D) Forensic odontology (dental charting)

54. Which forensic principle provides the core scientific rationale for why police officers must secure a crime scene immediately and restrict unauthorized access?
(A) The foundational Principle of Standard Evidence Comparison
(B) The hypothetical Principle of Absolute Judicial Certainty
(C) Law of Progressive Change and Exchange Principle
(D) The statistical Principle of Probable Evidence Frequency

55. Which of the following forensic pioneers is primarily associated with the analysis of firearms and ballistics rather than the analysis of biological or trace evidence?
(A) Calvin Goddard
(B) Mathieu Orfila
(C) Alec Jeffreys
(D) Karl Landsteiner

56. Consider the following statements:
Statement I: The ancient text 'Hsi Duan Yu' documented early forensic techniques, including how to distinguish a drowning victim from one who was strangled before being thrown into water.
Statement II: This text is widely recognized as one of the earliest known medical-legal treatises in the world.
Choose the correct option:
(A) Both Statement I and Statement II are correct.
(B) Both Statement I and Statement II are incorrect.
(C) Statement I is correct but Statement II is incorrect.
(D) Statement I is incorrect but Statement II is correct.

57. Consider the following statements regarding the ethical role of forensic science in law enforcement:
I. Forensic science operates exclusively to aid the prosecution and must actively seek to convict the suspect.
II. Forensic evidence is neutral and can be used to exonerate an innocent person as effectively as it can incriminate a guilty one.
III. The primary ethical duty of a forensic scientist is to report the truth as revealed by physical evidence, irrespective of which side it benefits.
Which combination of statements is correct?

NODIA

(A) I and II
(B) II and III
(C) I and III
(D) I, II, and III

58. Kautilya's Arthashastra contains early historical references to the investigation of sudden deaths. What was the specific title given to the magistrate or investigative officer responsible for holding inquests under this system?
(A) Kotwal (Police Chief)
(B) Senapati (Commander)
(C) Pradeshta
(D) Amatya (Minister)

59. An investigator recovers a single hair from a crime scene. To determine its origin, the forensic scientist must examine it alongside a pulled hair sample from the suspect. This procedure relies on the:
(A) Principle of Analysis
(B) Law of Progressive Change
(C) Principle of Circumstantial Facts
(D) Principle of Comparison

60. While Karl Landsteiner discovered the ABO blood groups in 1900 using fresh blood, his discovery was not immediately useful at crime scenes. Who made it practically applicable to criminal investigations by developing a reliable test for dried bloodstains?
(A) Leone Lattes
(B) Edmond Locard
(C) Francis Galton
(D) Albert S. Osborn

61. The statistical proof of the uniqueness of fingerprints was first comprehensively documented in the 1892 book titled "Finger Prints". Who was its author?
(A) William Herschel
(B) Francis Galton
(C) Henry Faulds
(D) Juan Vucetich

62. The Directorate of Forensic Science Services (DFSS) manages several Central Forensic Science Laboratories (CFSLs) in India. Which of the following cities does NOT host a CFSL operating under the DFSS or the CBI?
(A) Chandigarh
(B) Lucknow
(C) Hyderabad
(D) Kolkata

63. Identify the INCORRECT statement regarding the fundamental principles of forensic science.
(A) The Principle of Individuality affirms that absolute identical twins have completely identical friction ridge fingerprint patterns.
(B) The Law of Progressive Change warns that the passage of time alters the condition of crime scenes and physical evidence.
(C) Locard's Exchange Principle asserts that contact between two items results in a transfer of trace materials.
(D) The Principle of Probability is used to estimate the likelihood that a specific DNA profile randomly matches another in the population.

64. Why is the Principle of Circumstantial Facts considered so crucial in forensic jurisprudence?
(A) Because circumstantial evidence is legally required to be accompanied by a recorded confession.
(B) Because physical evidence can be easily manipulated by judges in the courtroom.
(C) Because human witnesses can be deceived, biased, or forgetful, whereas physical facts cannot willfully lie.
(D) Because circumstantial facts always provide an absolute identification of the perpetrator without any analysis.

65. The world's first officially recognized police crime laboratory was established in 1910 in which city?
(A) London, UK
(B) New York, USA
(C) Berlin, Germany
(D) Lyon, France

66. While serving as the Inspector General of Police in Bengal, this British official, along with Azizul Haque and Hem Chandra Bose, developed a fingerprint classification system that was adopted across most of the English-speaking world. Who was he?
(A) William Herschel
(B) Henry Faulds
(C) Edward Henry
(D) Charles Tegart

67. Consider the following statements regarding the limitations of forensic science:
Statement I: Forensic science is entirely infallible and can definitively solve any crime without the need for traditional police investigation or witness interviews.

Downloaded from www.pdf.tube

Statement II: The evidentiary value of forensic analysis is heavily dependent on the proper collection, preservation, and chain of custody maintained by the first responders.
Choose the correct option:
(A) Both Statement I and Statement II are correct.
(B) Both Statement I and Statement II are incorrect.
(C) Statement I is correct but Statement II is incorrect.
(D) Statement I is incorrect but Statement II is correct.

68. What was the primary limitation of Bertillon's anthropometric system that eventually led to its worldwide replacement by fingerprinting?
(A) The complex scientific equipment required for taking measurements was highly radioactive and physically dangerous to subjects.
(B) It mandatorily required criminal suspects to provide invasive blood samples, which violated early fundamental constitutional legal rights.
(C) The mandatory statistical calculations required advanced electronic computers, which did not exist anywhere in the world at the time.
(D) Measurements varied between officers and body dimensions altered over time.

69. According to the Bharatiya Sakshya Adhiniyam, 2023, the provision dealing with the "Opinions of experts" which empowers courts to admit forensic reports as expert testimony is outlined in:
(A) Section 39
(B) Section 25
(C) Section 45
(D) Section 161

70. A person consumes a large amount of alcohol but is not blood-tested until 12 hours later. The forensic result shows a blood alcohol concentration of zero. This loss of evidence due to metabolic processing is an internal physiological example of which principle?
(A) Principle of Individuality
(B) Principle of Exchange
(C) Law of Progressive Change
(D) Principle of Comparison

71. The etymological root of the word 'forensic' is associated with the Roman 'forum'. What was the function of the forum in ancient Rome?
(A) A public square where civic debates and legal trials were held
(B) A heavily fortified secure facility utilized specifically for housing convicted Roman criminals
(C) A specialized laboratory setting designed exclusively for medieval alchemical experiments
(D) A designated sacred burial ground set aside specifically for murder and treason victims

72. When an expert testifies that the chance of a random individual having the same DNA profile as the evidence found at the scene is 1 in 10 billion, the expert is heavily relying on which principle?
(A) Principle of Exchange
(B) Principle of Circumstantial Facts
(C) Principle of Comparison
(D) Principle of Probability

73. In the context of educational and structural pathways in Indian forensic science, where is the main campus of the National Forensic Sciences University (NFSU), an institution of national importance, located?
(A) Lucknow, Uttar Pradesh
(B) Gandhinagar, Gujarat
(C) Bhopal, Madhya Pradesh
(D) Hyderabad, Telangana

NODIA

74. In which year was the first Fingerprint Bureau in the world formally established by the Government of India in Calcutta?
(A) 1849
(B) 1887
(C) 1897
(D) 1892

75. Identify the correctly matched pair of the forensic scientist and their area of distinction.
(A) Dr. Hans Gross - DNA Profiling Analysis
(B) Mathieu Orfila - System of Anthropometry
(C) Leone Lattes - Examination of Questioned Documents
(D) Calvin Goddard - Forensic Ballistics

76. In the Indian legal system, what unique privilege is granted to a forensic scientist testifying as an 'expert witness' under the evidence act, which is generally denied to an ordinary witness?

(A) The right to give professional opinions and inferences from facts
(B) The administrative right to immediately arrest any hostile witness appearing inside the courtroom
(C) The legal privilege to completely refuse cross-examination questioning by the defense counsel
(D) The judicial power to dictate the final binding guilt verdict directly to the trial judge

77. The interdisciplinary scope of forensic science encompasses numerous specialized applied fields. Which of the following is an applied branch of forensic science dealing specifically with bite marks and dental identification?
(A) Forensic Pathology
(B) Forensic Odontology
(C) Forensic Entomology
(D) Forensic Serology

78. In the context of criminalistics, how is a 'Questioned Document' formally defined?
(A) Any written legal document that contains signed confessions provided directly by primary criminal suspects
(B) Any document with marks whose origin or authenticity is in dispute
(C) Any official government-issued monetary currency note or paper bond that has been physically torn or damaged
(D) Any document or written communication that has been executed strictly through the use of invisible chemical inks

79. Alphonse Bertillon, who revolutionized criminal identification before the advent of fingerprinting, was a police officer in which European capital?
(A) Paris
(B) London
(C) Berlin
(D) Rome

80. A forensic toolmark examiner compares striations on a pried-open lock with a crowbar found on a suspect. The examiner assumes that the unique manufacturing defects on the crowbar cannot be perfectly duplicated on any other crowbar in the world. This assumption rests on the:
(A) Law of Progressive Change
(B) Principle of Circumstantial Facts
(C) Principle of Individuality
(D) Locard's Exchange Principle

81. Consider the following statements regarding the 'Chain of Custody':
Statement I: The chain of custody is a strict chronological documentation showing the seizure, custody, control, transfer, and analysis of physical evidence.
Statement II: A documented break in the chain of custody has no impact on the admissibility of the evidence in a court of law.
Choose the correct option:
(A) Both Statement I and Statement II are correct.
(B) Both Statement I and Statement II are incorrect.
(C) Statement I is correct but Statement II is incorrect.
(D) Statement I is incorrect but Statement II is correct.

82. What was the historical significance of the famous "Will West" case at Leavenworth Penitentiary in 1903?
(A) It conclusively proved the absolute scientific infallibility of Alphonse Bertillon's anthropometric system worldwide.
(B) It marked the historical milestone of being the first criminal case globally to be solved using forensic DNA profiling.
(C) It showed two men had near-identical measurements, spurring fingerprint use.
(D) It highlighted an urgent necessity for implementing strict federal government regulations on forensic toxicology testing.

83. The historical development of chemical analysis in Indian criminal investigations began with the establishment of the first Chemical Examiner's Laboratory. In which year was this laboratory instituted?
(A) 1897
(B) 1849
(C) 1910
(D) 1952

84. Identify the INCORRECT pairing of the forensic principle with its core tenet.
(A) Locard's Exchange Principle - Physical contact between two items inevitably leaves trace evidence
(B) Principle of Individuality - Nature never repeats any of its creations exactly identical in all respects
(C) Principle of Comparison - Only comparable standard items of similar origin can be

Click Here to Buy book on Flipkart

validly evaluated
(D) Law of Progressive Change - Matter is indestructible and unchanging

85. Emerging trends in modern forensic science rapidly expand its scope. Which of the following represents a major current trend enhancing pattern recognition (like fingerprint matching and ballistics)?
(A) Using Artificial Intelligence and Machine Learning algorithms
(B) The widespread official reversion to manual 19th-century anthropometric physical body measurements
(C) The exclusive statutory adoption of cranial Phrenology measurements for suspect psychological profiling
(D) The gradual global phasing out of comparison microscopes in physical trace evidence analysis procedures

86. A forensic team seizes 100 identical packets of suspected heroin but only analyzes a tiny pinch from one single packet, subsequently claiming all 100 packets contain heroin. Which scientific principle was most directly violated by this poor sampling strategy?
(A) Law of Progressive Change
(B) Principle of Circumstantial Facts
(C) Principle of Analysis
(D) Principle of Individuality

87. Hans Gross, widely credited with establishing the field of criminalistics, published his comprehensive manual for criminal investigators in which year?
(A) 1893
(B) 1814
(C) 1879
(D) 1910

88. Based on the Law of Progressive Change and Locard's Exchange Principle, what is the most critical duty of the First Responding Officer at a crime scene?
(A) To immediately detain and intensely interrogate all present suspects before police backup arrives on scene
(B) To physically touch and move suspected evidence items to evaluate whether they are relevant to the active case
(C) To conduct an urgent press conference briefing the media on preliminary physical findings of the investigation
(D) To secure the scene to prevent evidence contamination or loss

NODIA

89. Prior to the systematic application of science to law, early judicial systems frequently relied on unscientific methods to determine guilt or innocence. Which of the following is a classic example of such a pre-scientific method?
(A) DNA Fingerprinting
(B) Trial by Ordeal
(C) Blood Spatter Analysis
(D) Gas Chromatography

90. Following the success of anthropometry in Europe, the British administration established an Anthropometric Bureau in India for criminal identification. In what year was this bureau set up in Calcutta?
(A) 1849
(B) 1876
(C) 1892
(D) 1897

www.nodia.in

ANSWERS

1. (D) Of or before the forum
The term forensic originates directly from the Latin word forensis, which translates to of or before the forum. In ancient Rome, the forum served as the public meeting place where legal matters, judicial proceedings, and civic debates took place. Consequently, the word historically denotes open public discourse and matters pertaining directly to courts of law.

2. (C) The application of physical and natural sciences to analyze physical evidence
Criminalistics represents a specialized discipline within forensic science focused on the collection, identification, individualization, and scientific examination of physical evidence. By integrating fundamental principles from chemistry, biology, and physics, criminalistics provides objective analytical evaluation of physical materials retrieved from crime scenes. This discipline plays a pivotal role in linking suspects, victims, and scenes during legal investigations.

3. (B) P-2, Q-3, R-1, S-4
Mathieu Orfila earned recognition as the pioneer of forensic toxicology through his systematic study of poisons. Alphonse Bertillon devised anthropometry, an early physical measurement system for personal identification. Francis Galton published groundbreaking work on fingerprint classification, proving their uniqueness. Hans Gross established the field of criminalistics by writing the first comprehensive handbook applying scientific disciplines to criminal investigations.

4. (D) Locard's Exchange Principle
Formulated by Edmond Locard, Locard's Exchange Principle asserts that whenever two objects or individuals come into physical contact, a mutual transfer of material occurs. This foundational concept implies that a perpetrator inevitably leaves trace evidence at a crime scene while simultaneously taking away microscopic debris, establishing a crucial physical link between the suspect, victim, and environment.

5. (A) Forensic medicine and entomology
Authored in 1248 by Song Ci during the Song Dynasty, Hsi Duan Yu stands as a historical landmark in legal medicine. The text documents systematic procedures for examining cause of death and features the earliest recorded instance of forensic entomology, demonstrating how blowflies were used to identify a murder weapon and locate a guilty suspect.

6. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Microscopic wear, cuts, and random imperfections acquire on footwear during usage, producing unique individual characteristics that allow forensic examiners to match a shoe print to a specific sole. This physical matching process directly illustrates the Principle of Individuality, which states that no two items, whether natural or manufactured, can ever be completely identical in all detailed respects.

7. (A) 1849, Madras
The official institutional history of forensic science in India commenced with the establishment of the Chemical Examiner's Laboratory in Madras in 1849. Created under British administration, this facility was primary established to perform scientific toxicological examinations in cases of suspected poisoning, laying the institutional groundwork for modern central and state forensic laboratories across the country.

8. (D) Law of Absolute Certainty
Forensic science relies on foundational laws including the Principle of Individuality, Locard's Exchange Principle, Law of Progressive Change, Principle of Comparison, Principle of Analysis, and Principle of Probability. Absolute certainty is not recognized as a law because scientific evaluations inherently express conclusions based on empirical probabilities, standard error thresholds, and statistical confidence levels rather than absolute infallibility.

9. (B) I and III
Forensic science functions as an applied science that adapts fundamental theories, analytical methodologies, and laws from physics, chemistry,

NODIA

and biology to address legal matters. It combines laboratory testing with field investigations to solve both criminal and civil disputes. It is not limited to homicides, as civil litigations frequently utilize document analysis, toxicology, and environmental trace testing.

10. (A) 2, 1, 3, 4
The Chemical Examiner's Laboratory was established in Madras in 1849. Decades later, the Anthropometric Bureau was set up in Calcutta in 1892 to record bodily measurements. Following this, the world's first dedicated Fingerprint Bureau was instituted in Calcutta in 1897. Finally, India's first Central Forensic Science Laboratory was formally established in Calcutta in the year 1957.

11. (D) Principle of Comparison
The Principle of Comparison dictates that physical evidence recovered from a crime scene can only be meaningfully evaluated when compared alongside a known reference standard of similar nature. To determine whether an questioned footprint belongs to a suspect, examiners must generate a control test impression using the suspect's shoe under controlled laboratory conditions to analyze matching characteristics.

12. (A) To provide objective scientific facts to assist courts in justice
The paramount objective of forensic science within the criminal justice framework is to furnish objective, unbiased scientific evidence to assist judicial authorities in determining truth. Forensic experts do not replace police investigators, act as advocates, or seek convictions; instead, they provide impartial scientific evaluation of physical evidence to support fair legal decisions in court.

13. (B) The world's first Fingerprint Bureau
In 1897, the world's first Fingerprint Bureau was established in Calcutta, India. Operating under the leadership of Sir Edward Henry along with Indian sub-inspectors Azizul Haque and Hem Chandra Bose, this institution introduced a revolutionary classification system that replaced anthropometry and transformed personal identification methods across global law enforcement agencies during the late nineteenth century.

14. (B) I, II, and III
Kautilya's Arthashastra provides extensive ancient guidelines on legal administration and criminal investigation. It details procedures for examining unnatural or sudden deaths to detect foul play and describes methods for identifying poisoned food by observing abnormal animal behavior. Furthermore, the text designates special investigating officers called Pradeshta, explicitly mandating post-mortem physical examinations rather than prohibiting them.

15. (A) Edmond Locard
Dr. Edmond Locard established the world's first functional police crime laboratory in 1910 in Lyon, France. Operating initially from a modest attic space provided by the Lyon Police Department, Locard demonstrated the practical value of scientific evidence analysis in criminal investigations, earning him lasting recognition as a pioneer in modern forensic science and criminalistics.

16. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Biological samples like blood and semen undergo rapid degradation when exposed to heat, humidity, and atmospheric microbes. This physical deterioration directly exemplifies the Law of Progressive Change, which dictates that every physical material continuously alters over time. Consequently, prompt collection and appropriate preservation are vital to prevent trace evidence destruction prior to laboratory analysis.

17. (D) Locard's Principle of Exchange
The mutual transfer of microscopic paint chips onto a victim's clothing and garment fibers onto a vehicle's bumper perfectly exemplifies Locard's Exchange Principle. This principle asserts that whenever physical contact occurs between two objects, material from each object is transferred to the other, creating essential physical links that allow forensic scientists to connect suspects with scenes.

18. (C) Section 39
Under the modern legal framework of India, Section 39 of the Bharatiya Sakshya Adhiniyam governs the admissibility of expert opinions in judicial proceedings. This statutory provision allows courts to consider specialized scientific findings, analytical reports, and expert testimony

Downloaded from www.pdf.tube

submitted by forensic scientists, replacing the legacy provision previously codified under Section 45 of the Indian Evidence Act.

19. (B) P-4, Q-1, R-3, S-2
Calvin Goddard advanced ballistics by utilizing the comparison microscope to match bullets. Albert S. Osborn established document examination as a scientific discipline with his book Questioned Documents. Leone Lattes devised a reliable method to determine ABO blood groups from dried stains. Alec Jeffreys revolutionized forensic genetics by developing the first DNA fingerprinting technique in 1984.

20. (A) Discovery of the ABO blood group system → Discovery of a method to group dried bloodstains → Invention of DNA fingerprinting
Karl Landsteiner discovered the human ABO blood group system in 1900, establishing the foundation of serology. In 1915, Leone Lattes devised a practical technique to determine blood types from dried bloodstains on physical evidence. Decades later, in 1984, Sir Alec Jeffreys developed DNA fingerprinting, revolutionizing biological identification techniques used in modern criminalistics.

21. (A) Kautilya's Arthashastra
Kautilya's Arthashastra is an ancient Indian treatise that contains early recorded procedures for death investigation. The text provides specific instructions for examining corpses to identify indicators of poisoning, strangulation, hanging, or drowning. It emphasizes inspecting internal organ discoloration, surface marks, and physical fluids, serving as a historical precursor to formal medico-legal post-mortem inquests.

22. (C) Statement I is correct but Statement II is incorrect.
Alphonse Bertillon pioneered anthropometry, a scientific identification system utilizing precise physical body measurements and structural descriptions. However, anthropometry did not persist into the late twentieth century; it was rapidly abandoned and replaced across the globe by fingerprint identification in the early 1900s due to the superior reliability, efficiency, and uniqueness of friction ridge analysis.

23. (A) The ABO human blood group system
In 1900, Austrian scientist Karl Landsteiner made the groundbreaking discovery of the human ABO blood group system. By identifying distinct agglutinin antibodies and red cell antigens, Landsteiner explained blood transfusion reactions and laid the essential scientific foundation for forensic serology, enabling scientists to categorize bloodstains recovered from crime scenes.

NODIA

24. (D) Principle of Probability
The Principle of Probability states that all forensic identifications and conclusions rely on mathematical likelihood rather than absolute mathematical certainty. Forensic results, such as matching DNA profiles or fingerprint ridge details, are evaluated by calculating the statistical probability of finding identical traits in the general population, ensuring scientific objectivity during legal evaluations.

25. (B) I and II
Forensic scientists operate primarily as objective analysts within laboratory environments, applying scientific protocols to evaluate physical evidence submitted by law enforcement. They compile formal analytical reports and provide expert testimony regarding their technical findings in court. However, forensic scientists do not possess executive police powers to make arrests, execute search warrants, or perform field arrests.

26. (C) Criminology studies the social causes of crime, whereas Criminalistics applies natural sciences to examine physical evidence.
Criminology is a branch of sociology that examines crime as a social phenomenon, investigating its underlying psychological causes, societal impacts, and criminal behaviors. In contrast, Criminalistics is a subfield of forensic science that directly applies chemistry, physics, and biology to detect, collect, identify, and compare physical trace evidence connected to legal investigations.

27. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Physical evidence analyzed under the Principle of Circumstantial Facts provides objective value because physical objects cannot suffer from memory failure, bias, or intentional deceit. Eyewitness accounts are frequently vulnerable to cognitive distortion or personal prejudice. Consequently, scientific analysis of physical facts offers impartial evidence that often carries greater evidentiary weight in legal proceedings.

28. (A) Alec Jeffreys
In 1984, British geneticist Sir Alec Jeffreys developed the first method of DNA profiling while working at the University of Leicester. By discovering variable repeat sequences in human DNA, Jeffreys provided a revolutionary technique capable of individualizing biological evidence, completely transforming personal identification in forensic biology and criminal investigations worldwide.

29. (B) P-3, Q-4, R-1, S-2
Proper sampling and contamination control reflect the Principle of Analysis. Transferring trace fibers during physical contact demonstrates Locard's Exchange Principle. Promptly photographing transient tire marks before weather degradation addresses the Law of Progressive Change. Using physical evidence to challenge or corroborate witness statements exemplifies the application of the Principle of Circumstantial Facts.

30. (B) Calcutta
The British administrative authorities established the Anthropometric Bureau in Calcutta in 1892. Based on Alphonse Bertillon's identification framework, this institutional facility recorded standardized physical body measurements of convicted criminals to maintain systematic criminal records, marking a key structural development in the historical evolution of forensic science in nineteenth-century India.

31. (A) Song Ci
Song Ci, a prominent Chinese judicial officer of the Song Dynasty, authored the landmark legal text Hsi Duan Yu in 1248. The book details a murder investigation where all villagers surrendered their sickles, but blowflies clustered on only one blade due to invisible blood residue, forcing the guilty owner to confess his crime.

32. (C) Principle of Analysis
The Principle of Analysis asserts that the quality, validity, and accuracy of any laboratory outcome depend directly on the integrity of the sample provided and the correctness of the analytical procedure used. Sophisticated laboratory instruments cannot rectify errors caused by improper sampling, improper packaging, contamination, or flawed testing methodologies during processing.

33. (D) It routinely predicts the specific dates and times a suspect will commit future offenses.
Forensic science evaluates physical trace evidence from past events to reconstruct occurrences and establish factual connections. It operates strictly on empirical evidence, chemical testing, and physical comparison. It possesses no scientific capability to predict future criminal acts, specific dates, or times of prospective offenses, as such speculative predictions fall completely outside empirical scientific methods.

34. (C) I, II, and III
The world's first Fingerprint Bureau was officially established in Calcutta in 1897. Indian police officers Azizul Haque and Hem Chandra Bose played crucial historical roles in developing the mathematical formula and classification system used there. The bureau focused on criminal record management and personal identification rather than monitoring digital or modern cybercrime activities.

35. (A) 3, 2, 1, 4
Mathieu Orfila published his seminal treatise on toxicology in 1814. Hans Gross published his manual on criminal investigation in 1893, formally establishing criminalistics. Albert S. Osborn released Questioned Documents in 1910, standardizing document analysis. Finally, Sir Alec Jeffreys invented DNA fingerprinting in 1984, establishing the chronological progression of these major developments.

36. (D) Mathieu Orfila
Spanish physician Mathieu Orfila is widely celebrated as the father of modern forensic toxicology. In 1814, he published a groundbreaking treatise detailing the chemical properties, physiological effects, and detection methods for various poisons in animal tissues, establishing chemical analysis as a crucial scientific discipline within legal medicine and courtroom proceedings.

37. (A) It synthesizes principles from chemistry, biology, physics, and mathematics to analyze legal evidence.
Forensic science is intrinsically interdisciplinary, integrating concepts and analytical tools from chemistry, biology, physics, geology, and mathematics to evaluate physical evidence. Rather than operating as an isolated field, it adapts proven methodologies from pure sciences

Click Here to Buy book on Amazon

to solve legal problems, answer investigative questions, and present objective scientific evidence inside courtroom proceedings.

38. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
When a burglar shatters a window, contact between the breaking glass and the offender's clothing results in the transfer of microscopic glass fragments. This phenomenon directly reflects Locard's Exchange Principle, which states that physical contact between two objects always causes an exchange of trace matter, providing detectable evidence for analysis.

39. (A) Hans Gross
Hans Gross, an Austrian jurist and prosecutor, coined the term Criminalistics and advocated using scientific disciplines in criminal investigations. In 1893, he published his influential treatise Handbuch für Untersuchungsrichter (Criminal Investigation), which systematically detailed how fields like chemistry, physics, and botany could be effectively applied to analyze crime scene evidence.

40. (D) I and III
The Principle of Comparison dictates that physical evidence can only be validly compared against known reference standards of similar nature, such as matching a questioned bullet to a control bullet fired from a specific gun. Comparing completely unrelated materials, like a fingerprint pattern to a tire tread design, violates this fundamental scientific rule.

41. (A) Both Statement I and Statement II are correct.
The Principle of Analysis stresses that advanced laboratory instruments cannot overcome errors introduced by poor sampling or contaminated evidence. Consequently, meticulous scene packaging, proper preservation, and strict adherence to handling protocols are necessary to maintain physical sample integrity, ensuring that subsequent laboratory analyses yield reliable and legally admissible results.

42. (C) Chemical Examiner's Laboratory
The first dedicated scientific facility for criminal investigation in India was the Chemical Examiner's Laboratory, established in Madras in 1849. Created under British governance, this institution primarily conducted toxicological analyses in cases involving suspected poisonings, initiating the structured application of chemical sciences to the Indian medico-legal justice system.

43. (D) P-4, Q-3, R-1, S-2
Post-mortem decay reflects the Law of Progressive Change over time. Handling evidence without protective gear causes cross-contamination under Locard's Exchange Principle. Calculating DNA match frequencies relies on the Principle of Probability. Evaluating questioned handwriting against standard control exemplars demonstrates the practical execution of the Principle of Comparison during forensic document examinations.

44. (A) Forum
The word forensic traces its etymology back to the Latin term forensis, which refers to the forum of ancient Rome. The forum was a prominent public square where Roman citizens gathered for judicial trials, political debates, and public affairs, establishing the connection between forensic scientific work and formal court proceedings.

NODIA

45. (B) Theoretical Astrology
Forensic science relies strictly on empirical, reproducible, and tested disciplines such as analytical chemistry, molecular biology, physics, and material science. Theoretical astrology is an unscientific belief system lacking empirical validation, standardized testing, or physical proof, rendering it completely invalid and excluded from legitimate scientific inquiry and judicial proceedings.

46. (B) Leone Lattes
In 1915, Italian researcher Dr. Leone Lattes developed a practical procedure to restore dried bloodstains and determine their ABO blood group categories. This scientific breakthrough transformed serological evidence processing by allowing investigators to test dried blood found at crime scenes, making Karl Landsteiner's earlier discovery directly applicable to criminal investigations.

47. (B) Recognition of Evidence → Collection and Preservation → Laboratory Analysis → Court Testimony
The logical sequence of forensic investigation begins with recognizing relevant physical

evidence at a crime scene. Next, officers properly collect and preserve the items to prevent contamination. The evidence then undergoes scientific laboratory analysis, culminating in the expert presenting objective findings and scientific interpretations as courtroom testimony during legal proceedings.

48. (C) To present objective scientific facts to the court to determine truth
The core objective of a forensic scientist in the criminal justice system is to evaluate physical evidence impartially and report objective scientific facts. Forensic experts operate independently of prosecution or defense biases, aiming solely to provide reliable scientific findings that assist judges and juries in discovering the truth during legal proceedings.

49. (D) I, II, and IV
Colonel Calvin Goddard is celebrated as the father of modern forensic ballistics. He adapted the comparison microscope for bullet and cartridge case examinations and helped establish the Scientific Crime Detection Laboratory at Northwestern University. However, he did not create fingerprint classification systems, which were developed by Galton, Henry, Vucetich, and others.

50. (C) Albert S. Osborn
Albert S. Osborn published the seminal textbook Questioned Documents in 1910. This treatise established the scientific principles of handwriting identification, forgery detection, and document analysis. Osborn's work formalized document examination into an accepted forensic discipline, providing standard methodologies that remain fundamental to modern questioned document analysis in legal proceedings.

51. (B) Principle of Individuality
The uniqueness of friction ridge patterns on human fingers directly exemplifies the Principle of Individuality. This foundational concept asserts that nature never duplicates any creation exactly, meaning no two individuals, including monozygotic identical twins, share identical fingerprint ridge details, providing an absolute basis for personal identification in forensic science.

52. (D) Ministry of Home Affairs
The Directorate of Forensic Science Services operates as an attached office under the Ministry of Home Affairs, Government of India. It oversees Central Forensic Science Laboratories across the country, formulates national policies, standardizes quality control protocols, and promotes research and development in forensic science to support law enforcement and justice administration.

53. (A) Anthropometry (body measurements)
Before fingerprinting gained global acceptance, police forces relied heavily on anthropometry, created by Alphonse Bertillon in the late nineteenth century. This system recorded eleven precise physical body measurements, alongside descriptive features and photographs, to establish a systematic record system for identifying repeat criminal offenders across international judicial systems.

54. (C) Law of Progressive Change and Exchange Principle
Securing a crime scene immediately prevents physical alteration caused by the Law of Progressive Change and prevents unwanted material transfer under Locard's Exchange Principle. Uncontrolled scene access can introduce extraneous trace evidence or destroy existing fragile physical marks, compromising sample integrity and rendering subsequent laboratory analyses invalid in legal proceedings.

55. (A) Calvin Goddard
Colonel Calvin Goddard was a pioneer who specialized in forensic ballistics and firearm identification. He refined the comparison microscope to examine striations on fired bullets and shell casings, establishing methods to link ammunition to specific firearms. Other listed pioneers made primary contributions to toxicology, DNA profiling, and blood typing.

56. (A) Both Statement I and Statement II are correct.
The 1248 Chinese text Hsi Duan Yu provides early instructions for forensic death investigations, including distinguishing between ante-mortem drowning and post-mortem submersion after strangulation. Scholars recognize this text as one of the earliest written legal medicine handbooks, documenting systematic procedures for evaluating physical trauma on human corpses.

Downloaded from www.pdf.tube

57. (B) II and III
Forensic science operates as an impartial, neutral discipline whose sole purpose is to uncover factual truth through physical evidence analysis. Forensic evidence can exonerate innocent individuals just as effectively as it implicates guilty suspects. A forensic scientist's ethical obligation is to present truthful scientific findings regardless of which legal party benefits.

58. (C) Pradeshta
In Kautilya's Arthashastra, the investigating magistrate or official tasked with conducting inquests into sudden, unexpected, or suspicious deaths was designated as the Pradeshta. This official examined physical signs on deceased bodies, questioned potential witnesses, investigated possible poisonings, and determined whether unnatural deaths involved criminal acts or foul play.

59. (D) Principle of Comparison
Examining a crime scene hair alongside a known reference hair pulled from a suspect directly applies the Principle of Comparison. Forensic identification requires evaluating questioned evidence against standardized control samples of identical class origin to identify matching microscopic characteristics, such as medullary index, pigmentation patterns, and cuticle structures.

60. (A) Leone Lattes
Although Karl Landsteiner discovered the ABO blood group system in 1900 using liquid blood, Dr. Leone Lattes made this discovery practical for criminalistics in 1915. Lattes created a simple technique to test and determine the ABO blood group from dried bloodstains, enabling police laboratories to analyze blood evidence.

61. (B) Francis Galton
Sir Francis Galton published his landmark book Finger Prints in 1892. In this text, Galton provided the first detailed statistical proof of the uniqueness and permanence of human friction ridge patterns, establishing a classification system that laid the theoretical foundation for adopting fingerprinting in global criminal identification.

62. (B) Lucknow
Central Forensic Science Laboratories under the Directorate of Forensic Science Services or the Central Bureau of Investigation are situated in major cities including Chandigarh, Hyderabad, Kolkata, Pune, Guwahati, Bhopal, and New Delhi. Lucknow hosts a major State Forensic Science Laboratory, but it does not contain a Central Forensic Science Laboratory facility.

63. (A) The Principle of Individuality affirms that absolute identical twins have completely identical friction ridge fingerprint patterns.
Monozygotic identical twins share identical DNA profiles, but they do not possess identical fingerprint patterns. Friction ridge development is influenced by random environmental factors in the womb, resulting in unique ridge formations for every individual. Claiming identical twins share identical fingerprints directly violates the foundational forensic Principle of Individuality.

NODIA

64. (C) Because human witnesses can be deceived, biased, or forgetful, whereas physical facts cannot willfully lie.
Circumstantial physical evidence is critical in forensic jurisprudence because physical objects do not suffer from bias, faulty memory, fear, or deliberate perjury. While eyewitness testimony can be mistaken or influenced by emotions, physical facts analyzed through scientific protocols provide an objective, unchanging basis for establishing truth in court.

65. (D) Lyon, France
The world's first official police crime laboratory was established in Lyon, France, in 1910 by Dr. Edmond Locard. Setting up operations in two attic rooms provided by the Lyon Police Department, Locard demonstrated the practical value of applying scientific methods to analyze trace evidence in active criminal investigations.

66. (C) Edward Henry
Sir Edward Henry, serving as Inspector General of Police in Bengal during the late nineteenth century, collaborated with Indian sub-inspectors Azizul Haque and Hem Chandra Bose to create the Henry Classification System. This ten-digit fingerprint classification method was officially adopted across British India and subsequently utilized by police agencies worldwide.

67. (D) Statement I is incorrect but Statement II is correct.
Forensic science is not infallible and cannot replace comprehensive police investigations or

witness interviews. The evidentiary reliability of forensic analyses depends heavily on proper evidence collection, meticulous preservation, and maintaining an unbroken chain of custody. Faulty scene handling or compromised custody can alter physical evidence and invalidate laboratory results.

68. (D) Measurements varied between officers and body dimensions altered over time.
Bertillon's anthropometric system suffered from serious operational flaws, including measurement variations between different recording officers and natural changes in an individual's skeletal dimensions due to aging. These vulnerabilities led to misidentifications, ultimately causing police agencies worldwide to replace anthropometry with fingerprinting, which provides permanent and objective friction ridge traits.

69. (A) Section 39
In the updated criminal jurisprudence framework of India under the Bharatiya Sakshya Adhiniyam, 2023, Section 39 governs expert opinions. This statutory provision allows judicial courts to admit formal reports and testimonies from scientific experts, including forensic scientists, replacing Section 45 of the repealed Indian Evidence Act of 1872.

70. (C) Law of Progressive Change
The metabolic clearance of alcohol from the bloodstream over time illustrates the Law of Progressive Change. This principle dictates that all physical and biological systems undergo continuous alteration over time. Biological evidence undergoes dynamic changes, highlighting the necessity of prompt sample collection before physiological processes or environmental decay destroy trace evidence.

71. (A) A public square where civic debates and legal trials were held
The word forensic originates from the Latin forensis, connected to the forum of ancient Rome. The forum was a public plaza that served as the center of judicial trials, public debates, and administrative affairs. Modern forensic science reflects this heritage by applying scientific disciplines directly to legal issues debated in courts.

72. (D) Principle of Probability
Presenting match statistics such as a one in ten billion random match probability relies on the Principle of Probability. Forensic identifications do not claim absolute mathematical certainty; instead, they express the statistical likelihood of an observed match occurring by chance within a given population, providing a scientific basis for courtroom testimony.

73. (B) Gandhinagar, Gujarat
The main campus of the National Forensic Sciences University, recognized as an Institution of National Importance, is located in Gandhinagar, Gujarat. Established to promote advanced education, research, and training in forensic science and allied fields, NFSU operates specialized campuses across India and internationally to strengthen criminal justice education.

74. (C) 1897
The world's first Fingerprint Bureau was officially established in Calcutta, India, in 1897. Operating under Sir Edward Henry with crucial contributions from Azizul Haque and Hem Chandra Bose, the bureau introduced systematic friction ridge classification for criminal identification, replacing anthropometric measurements and setting a historical benchmark in global criminalistics.

75. (D) Calvin Goddard - Forensic Ballistics
Colonel Calvin Goddard is famous for establishing forensic ballistics as a rigorous scientific discipline by adapting the comparison microscope to analyze fired bullets and cartridge cases. The other options incorrectly pair pioneers: Hans Gross focused on criminalistics, Mathieu Orfila on toxicology, and Leone Lattes on serology and bloodstain group testing.

76. (A) The right to give professional opinions and inferences from facts
Under Indian evidence law, an expert witness possesses the special privilege of providing professional opinions and conclusions derived from specialized knowledge or scientific testing. Unlike ordinary lay witnesses, who must strictly restrict their courtroom testimony to direct factual observations, forensic experts are legally permitted to interpret complex physical evidence for the court.

Click Here to Buy book on Flipkart

77. (B) Forensic Odontology
Forensic Odontology is a specialized branch of forensic science that applies dental science to legal investigations. It focuses on identifying human remains using dental records, analyzing bite mark impressions found on victims or objects, and evaluating facial trauma, playing a vital role in mass disaster identifications and violent crime investigations.

78. (B) Any document with marks whose origin or authenticity is in dispute
In criminalistics, a questioned document is broadly defined as any document containing written, printed, or engraved marks whose source, authenticity, origin, or integrity is disputed or under investigation. This category includes forged checks, questioned wills, anonymous extortion notes, altered contracts, counterfeit currency, and disputed official records.

79. (A) Paris
Alphonse Bertillon served as a records clerk and police official with the Paris Police Prefecture in France. During the late nineteenth century, he created anthropometry, a systematic identification method based on standardized physical body measurements, establishing the first organized system used by European law enforcement to track repeat criminal offenders.

80. (C) Principle of Individuality
The toolmark examiner's assumption relies directly on the Principle of Individuality, which asserts that no two manufactured objects are identical in all minute details. Microscopic imperfections, wear patterns, and manufacturing defects uniquely individualize the crowbar's working edge, allowing scientists to link specific toolmarks left at a crime scene to a single tool.

81. (C) Statement I is correct but Statement II is incorrect.
The chain of custody is a formal, chronological log documenting the seizure, custody, transfer, and laboratory analysis of physical evidence. A documented breach in this chain compromises evidence integrity and can render physical items inadmissible in court, making strict adherence to chain of custody protocols essential for legal proceedings.

82. (C) It showed two men had near-identical measurements, spurring fingerprint use.
The 1903 Will West case at Leavenworth Penitentiary involved two unrelated inmates with identical anthropometric measurements and nearly identical physical appearances. This striking similarity demonstrated the operational flaws of Bertillon's anthropometric system, accelerating the global transition toward fingerprinting as a foolproof and permanent method for personal criminal identification.

83. (B) 1849
The formal history of chemical analysis in Indian criminal investigations began in 1849 with the establishment of the first Chemical Examiner's Laboratory in Madras. Instituted under British governance, this facility conducted toxicological examinations in cases of suspected poisoning, marking the beginning of organized forensic science infrastructure in India.

84. (D) Law of Progressive Change - Matter is indestructible and unchanging
The pairing for the Law of Progressive Change is incorrect because this law states that all physical objects change continuously over time. Environmental factors, decay, wear, and metabolic processes alter physical evidence. Claiming that matter is completely indestructible and unchanging contradicts this foundational concept of forensic science.

85. (A) Using Artificial Intelligence and Machine Learning algorithms
Modern forensic science integrates artificial intelligence and machine learning algorithms to enhance pattern recognition capabilities. These computational tools rapidly process vast databases of automated fingerprint identification systems, ballistics striation images, and facial recognition features, significantly improving the speed, objectivity, and accuracy of complex physical evidence comparisons during criminal investigations.

86. (C) Principle of Analysis
Analyzing a single pinch from one packet and improperly extrapolating that result to 99 unexamined packets directly violates the Principle of Analysis. This principle mandates that analytical findings are valid only when representative sampling protocols and correct testing procedures are followed, ensuring

Downloaded from www.pdf.tube

laboratory results accurately reflect the entire seized exhibit.

87. (A) 1893
Hans Gross published his foundational manual Handbuch für Untersuchungsrichter (Criminal Investigation) in 1893. This landmark work systematically demonstrated how scientific disciplines like chemistry, physics, microscopy, and botany could be integrated into legal investigations, establishing the formal discipline of criminalistics and modern physical evidence analysis across legal systems.

88. (D) To secure the scene to prevent evidence contamination or loss
According to the Law of Progressive Change and Locard's Exchange Principle, physical evidence deteriorates over time and is vulnerable to cross-contamination. The primary responsibility of the first responding officer is to secure the crime scene perimeter, restrict unauthorized access, and preserve transient trace evidence from environmental loss or human tampering.

89. (B) Trial by Ordeal
Before scientific methods were applied to legal disputes, ancient judicial systems relied on unscientific practices like Trial by Ordeal. Accused individuals were subjected to dangerous physical tests, such as carrying hot iron or immersion in water, under the superstitious belief that divine intervention would reveal guilt or innocence rather than empirical physical evidence.

90. (C) 1892
Following the adoption of Alphonse Bertillon's system in Europe, British administrative authorities established an Anthropometric Bureau in Calcutta in 1892. This institutional facility recorded standardized physical body measurements of convicted criminals, representing a major historical milestone in organized criminal identification systems in nineteenth-century India prior to fingerprinting.

NODIA

CHAPTER 02

Branches of Forensic Science and Role of Forensic Science Laboratories

1. Which of the following forensic disciplines is primarily concerned with the study and classification of fingerprints for personal identification?
(A) Forensic Palynology
(B) Dactyloscopy
(C) Forensic Odontology
(D) Forensic Anthropology

2. Forensic entomology is most frequently applied in criminal investigations to determine which of the following?
(A) The geographical origin of illicit drugs
(B) The presence of heavy metal poisoning in bones
(C) The trajectory of a fired bullet
(D) The post-mortem interval (time since death)

3. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Rifling in the barrel of a firearm imparts a spin to the fired bullet.
Reason (R): The spin stabilizes the bullet in flight and prevents it from tumbling.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

4. The forensic serology division of a State Forensic Science Laboratory is primarily responsible for the examination of which type of evidence?
(A) Explosive residues and petroleum products
(B) Paint flakes and glass fragments
(C) Blood, semen, saliva, and other body fluids
(D) Toolmarks and indented writings

5. Which of the following analyses does NOT typically fall under the scope of the Forensic Chemistry division?
(A) Species identification from skeletal remains
(B) Chemical analysis of petroleum residues in arson cases
(C) Detection and profiling of illicit drugs under NDPS Act
(D) Analysis of trap case washings using phenolphthalein test

6. Consider the following statements regarding Forensic Odontology:
I. It involves the estimation of age based on dental eruption patterns.
II. It includes the analysis of bite marks found on victims.
III. It relies heavily on the microscopic examination of hair cuticles.
Which of the above statement(s) is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

7. Match the forensic science division in List I with the corresponding evidence it examines in List II.
List I:
P. Forensic Physics
Q. Forensic Toxicology
R. Forensic Ballistics
S. Forensic Biology
List II:
1. Viscera and suspected poisons
2. Cartridge cases and firearms
3. Diatoms and botanical evidence
4. Glass fragments and soil comparisons
(A) P-4, Q-1, R-2, S-3
(B) P-1, Q-4, R-3, S-2
(C) P-4, Q-2, R-1, S-3
(D) P-3, Q-1, R-2, S-4

8. The recovery of deleted files, extraction of call detail records (CDRs), and analysis of malware are tasks performed by which branch of forensic science?
(A) Forensic Engineering and Structural Analysis

Click Here to Buy book on Amazon

(B) Forensic Accounting and Financial Auditing
(C) Digital and Cyber Forensics
(D) Forensic Psychiatry and Behavioral Sciences

9. Soil density gradient analysis and the measurement of the refractive index of glass fragments are standard examinations conducted in which division of a Forensic Science Laboratory?
(A) Forensic Biology
(B) Forensic Serology
(C) Forensic Linguistics
(D) Forensic Physics

10. Arrange the following steps representing the workflow of a case in a Forensic Science Laboratory in the correct chronological order:
1. Allotment of the exhibit to the specific scientific division
2. Receipt of sealed exhibits at the reception/ case receiving section
3. Preparation and dispatch of the forensic expert's report
4. Scientific examination and instrumental analysis of the exhibit

(A) 2, 1, 4, 3
(B) 1, 2, 3, 4
(C) 2, 4, 1, 3
(D) 4, 1, 2, 3

11. The Questioned Document (QD) examination division utilizes tools like the Electrostatic Detection Apparatus (ESDA) primarily for what purpose?
(A) Differentiating ink compositions
(B) Deciphering indented writings on paper
(C) Reading erased pencil writings
(D) Detecting counterfeit currency watermarks

12. Forensic palynology is defined as the application of which of the following to legal issues?
(A) The study of soil and geological evidence
(B) The study of pollen and spores
(C) The study of insect life cycles
(D) The study of skeletal pathologies

13. Which of the following represents the primary objective of a medico-legal autopsy conducted by a forensic pathologist?
(A) To determine the cause, manner, and mechanism of death
(B) To collect digital evidence from the victim's mobile phone
(C) To interrogate the suspect based on anatomical findings
(D) To reconstruct the financial history of the deceased

NODIA

14. Consider the following statements regarding Forensic Anthropology:
I. The pelvis is considered the most reliable skeletal structure for determining the sex of an adult.
II. Long bones such as the femur are utilized to estimate the stature of the deceased.
III. Cranial sutures provide vital information for estimating the age at death.
IV. The shape of the nasal aperture can assist in determining ancestry.
Which of the above statement(s) is/are correct?
(A) I, II, and III only
(B) II, III, and IV only
(C) I, II, and IV only
(D) I, II, III, and IV

15. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): A documented chain of custody is essential for physical evidence presented in court.
Reason (R): The chain of custody proves that the evidence was safely preserved, unaltered, and continuously accounted for from the crime scene to the laboratory.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

16. The Directorate of Forensic Science Services (DFSS), the nodal agency for forensic services in India, operates under the jurisdiction of which Union Ministry?
(A) Ministry of Health and Family Welfare
(B) Ministry of Science and Technology
(C) Ministry of Home Affairs
(D) Ministry of Law and Justice

17. The first Central Forensic Science Laboratory (CFSL) in India was established in the year 1957 in which city?
(A) New Delhi
(B) Kolkata
(C) Hyderabad
(D) Chandigarh

18. Consider the following statements regarding the National Forensic Sciences University (NFSU):
I. It has its main headquarters in Gandhinagar, Gujarat.
II. It has been accorded the status of an Institution of National Importance.
III. It operates strictly under the Ministry of Education.
Which of the above statement(s) is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

19. Match the institution in List I with its headquarters/location in List II.
List I:
P. Central Fingerprint Bureau
Q. National Forensic Sciences University
R. UP State Forensic Science Laboratory
S. LNJN NICFS
List II:
1. New Delhi
2. Gandhinagar
3. Lucknow
4. New Delhi
(A) P-1, Q-2, R-3, S-4
(B) P-4, Q-2, R-3, S-1
(C) P-1, Q-3, R-2, S-4
(D) P-2, Q-1, R-3, S-4

20. The Bureau of Police Research and Development (BPR&D) was established in 1970 primarily to fulfill which objective?
(A) To conduct direct criminal investigations of complex cybercrimes across state borders
(B) To serve as the apex judicial tribunal for resolving complex forensic disputes
(C) To modernise police forces and facilitate research in forensic science
(D) To manage international border security, passport issues, and visa clearances

21. The Directorate of Forensic Science in Uttar Pradesh oversees the State FSL and several Regional FSLs. Which of the following cities does NOT currently host a Regional Forensic Science Laboratory (RFSL) in Uttar Pradesh?
(A) Mathura
(B) Agra
(C) Varanasi
(D) Moradabad

22. In the Indian forensic framework, the institutions originally known as Government Examiner of Questioned Documents (GEQD) have been integrated into which laboratories?
(A) Regional and State Forensic Science Laboratories
(B) Apex National Institute of Virology Laboratories
(C) Technical Divisions of National Crime Records Bureau
(D) Central Forensic Science Laboratories

23. Select the correct hierarchical order of designations typically found within a State Forensic Science Laboratory, from highest to lowest authority:
(A) Director → Joint Director → Deputy Director → Scientific Officer
(B) Joint Director → Director → Scientific Officer → Deputy Director
(C) Director → Deputy Director → Joint Director → Scientific Officer
(D) Scientific Officer → Deputy Director → Joint Director → Director

24. The Central Finger Print Bureau (CFPB) in India functions under the administrative control of which organisation?
(A) Central Bureau of Investigation (CBI)
(B) Directorate of Forensic Science Services (DFSS)
(C) National Crime Records Bureau (NCRB)
(D) Bureau of Police Research and Development (BPR&D)

25. Forensic podiatry is primarily concerned with the analysis and evaluation of which of the following?
(A) Voice spectrograms and acoustic speaker identification
(B) Dental anomalies and bite marks
(C) Soil layering and stratigraphy
(D) Barefoot prints, footwear, and gait patterns

26. In Voice Analysis and Speaker Identification, the forensic expert typically examines acoustic features using a spectrograph. Which of the following is a primary parameter measured in this analysis?
(A) Pitch, formants, and frequency distributions
(B) Refractive index of the sound waves
(C) DNA composition of the saliva on the microphone
(D) Hemoglobin concentration in the vocal cords

Downloaded from www.pdf.tube

27. Consider the following statements regarding interrogative forensic techniques:
I. Polygraph examinations record physiological parameters like blood pressure, pulse, respiration, and skin conductivity.
II. Narco-analysis involves the intravenous administration of drugs like sodium pentothal to induce a trancelike state.
III. Brain Electrical Oscillation Signature (BEOS) profiling requires the subject to verbally answer a series of questions.
IV. In India, the administration of these tests without the subject's consent is unconstitutional as per the Supreme Court.
Which of the above statement(s) is/are correct?
(A) I, II, and III only
(B) I, II, and IV only
(C) II, III, and IV only
(D) I, III, and IV only

28. What is the primary role of Forensic Nursing in the criminal justice system?
(A) To offer psychological counseling and rehabilitation to cybercrime victims
(B) To care for trauma victims while gathering medico-legal evidence
(C) To analyze and secure digital evidence from electronic medical equipment
(D) To reconstruct vehicular traffic accidents using complex physics models

29. In India, suspected cases of wildlife crime, such as the identification of poached animal products, are often referred to which specialised premier institute?
(A) Wildlife Institute of India, Dehradun
(B) National Botanical Research Institute, Lucknow
(C) Centre for Cellular and Molecular Biology, Hyderabad
(D) National Crime Records Bureau, New Delhi

30. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Forensic linguistics can be utilized in the authorship attribution of anonymous threat letters.
Reason (R): Individuals exhibit unique subconscious habits in syntax, vocabulary, and grammar known as an idiolect.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

NODIA

31. Forensic archaeology is most aptly defined as the application of archaeological methods to:
(A) Evaluate ancient historical manuscripts and parchment for forgery
(B) Determine the absolute age and metallurgical composition of ancient coins
(C) Study structural architecture and design of historical prison buildings
(D) Recover human remains and buried physical evidence

32. Tracing illicit funds, detecting corporate embezzlement, and analyzing money laundering schemes are the domain of which forensic discipline?
(A) Forensic Psychiatry
(B) Forensic Geology
(C) Forensic Accounting
(D) Forensic Engineering

33. Match the forensic discipline in List I with the analytical technique or focus area in List II.
List I:
P. Forensic Botany
Q. Forensic Serology
R. Forensic Toxicology
S. Forensic Ballistics
List II:
1. Kastle-Meyer test for blood
2. Comparison microscope for striae
3. Diatom analysis in drowning cases
4. Thin Layer Chromatography for poisons
(A) P-3, Q-1, R-4, S-2
(B) P-1, Q-3, R-2, S-4
(C) P-3, Q-4, R-1, S-2
(D) P-4, Q-1, R-3, S-2

34. The microscopic examination of diatoms found in the bone marrow of a deceased individual is a crucial test in forensic pathology to confirm which cause of death?
(A) Strangulation
(B) Poisoning by arsenic
(C) Gunshot wound
(D) Ante-mortem drowning

35. Under the Bharatiya Sakshya Adhiniyam, 2023 (formerly Indian Evidence Act, 1872), the opinion of an expert is deemed a relevant fact under which section?

(A) Section 45
(B) Section 154
(C) Section 300
(D) Section 161

36. Arrange the fundamental steps of crime scene management by a first responder in the correct sequence:
1. Photographing and sketching the scene
2. Securing and isolating the crime scene
3. Packaging, sealing, and labeling of evidence
4. Systematic search for physical evidence
(A) 2, 1, 4, 3
(B) 1, 2, 3, 4
(C) 2, 4, 1, 3
(D) 4, 2, 1, 3

37. When a forensic expert is summoned by a court of law to testify regarding a forensic report, the legal document compelling their attendance is called a:
(A) Subpoena (Summons)
(B) Warrant
(C) Affidavit
(D) Injunction

38. Consider the following statements regarding the role of a forensic expert as a witness in court:
I. The expert is required to establish their credentials and qualifications before providing an opinion.
II. The expert's primary duty is to act as an advocate for the prosecution.
III. The expert is subjected to cross-examination by the defense counsel.
Which of the above statement(s) is/are correct?
(A) I and II only
(B) I and III only
(C) II and III only
(D) I, II, and III

39. Which of the following sections or divisions of an FSL is LEAST likely to handle the analysis of biological fluids and DNA profiles?
(A) Serology Division
(B) Ballistics Division
(C) Biology Division
(D) DNA Profiling Division

40. The primary reason for meticulously sealing physical evidence and obtaining signatures of witnesses at the crime scene is to:
(A) Ensure physical evidence is aesthetically presentable during court trials
(B) Reduce administrative workload and processing time of the laboratory
(C) Prevent contamination and maintain chain of custody
(D) Allow law enforcement agencies to quickly dispose of the case files

41. The primary function of a Mobile Forensic Science Laboratory (Mobile FSL) is to:
(A) Conduct long-term specialized DNA profiling and genetic analysis in remote areas
(B) Serve as a permanent secure storage facility for physical forensic exhibits
(C) Act as a mobile judicial courtroom for conducting summary criminal trials
(D) Provide immediate scientific support at crime scenes

42. The LNJN National Institute of Criminology and Forensic Science (NICFS), which provides comprehensive training to criminal justice functionaries, is located in:
(A) New Delhi
(B) Lucknow
(C) Hyderabad
(D) Gandhinagar

43. Select the correct sequence of phases typically involved in a standard Polygraph examination:
(A) In-test phase → Pre-test interview → Post-test interview → Chart analysis
(B) Pre-test interview → In-test phase → Chart analysis → Post-test interview
(C) Chart analysis → In-test phase → Pre-test interview → Post-test interview
(D) Pre-test interview → Post-test interview → In-test phase → Chart analysis

44. Which organisation is responsible for compiling the annual 'Crime in India' report and managing the National Automated Fingerprint Identification System (NAFIS)?
(A) BPR&D
(B) NCRB
(C) DFSS
(D) CFSL

45. The headquarters of the Uttar Pradesh State Forensic Science Laboratory, which serves as the apex forensic facility for the state police, is situated in:
(A) Lucknow
(B) Prayagraj
(C) Kanpur

Click Here to Buy book on Flipkart

(D) Varanasi

46. Consider the following statements regarding Brain Electrical Oscillation Signature (BEOS) profiling:
I. It is a non-invasive technique that measures electrical activity in the brain.
II. It is based on identifying the P300 event-related potential associated with experiential knowledge.
III. It requires the surgical implantation of electrodes into the cerebral cortex.
Which of the above statement(s) is/are incorrect?
(A) I only
(B) II only
(C) III only
(D) I and II only

47. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Monozygotic (identical) twins possess identical DNA profiles but have distinguishable and unique fingerprint patterns.
Reason (R): The formation of friction ridges on fingers is influenced by environmental factors within the womb, not merely genetics.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

48. Consider the following statements regarding Questioned Document Examination:
I. The Video Spectral Comparator (VSC) is used to differentiate inks by analyzing their behavior under various wavelengths of light.
II. Forged signatures created by tracing typically show signs of pen pauses and unnatural tremors under microscopy.
III. Paper can be analyzed based on thickness, opacity, watermark, and fiber composition.
IV. Thin Layer Chromatography (TLC) is a non-destructive test for analyzing ink.
Which of the above statement(s) is/are correct?
(A) I, II, and III only
(B) II, III, and IV only
(C) I, III, and IV only
(D) I, II, III, and IV

49. Match the UP Police Forensic/Cyber unit in List I with its operational context in List II.
List I:
P. State FSL Headquarters
Q. Cyber Crime Police Station (State Level Nodal)
R. Regional FSL, Agra
S. Field Unit (District Level)
List II:
1. Collects basic evidence at the district crime scenes
2. Handles complex cybercrime cases for the state
3. Operates out of Lucknow as the central forensic facility
4. Serves western UP districts for forensic analysis
(A) P-3, Q-2, R-4, S-1
(B) P-2, Q-3, R-1, S-4
(C) P-3, Q-4, R-2, S-1
(D) P-1, Q-2, R-3, S-4

NODIA

50. Forensic Geology primarily relies on the analysis of which of the following materials to link a suspect to a crime scene?
(A) Plant spores, pollen, and seeds
(B) Blood, semen, and biological traces
(C) Metallic gunshot residue particles
(D) Soil, minerals, and rock samples

51. The investigation of structural failures, building collapses, and vehicular accident reconstruction using physical principles is the domain of:
(A) Forensic Engineering
(B) Forensic Architecture
(C) Forensic Physics
(D) Forensic Geography

52. Which historical figure is widely regarded as the 'Father of Criminalistics' and authored the seminal book 'Handbuch für Untersuchungsrichter' (Manual for Examining Magistrates)?
(A) Edmond Locard
(B) Alphonse Bertillon
(C) Hans Gross
(D) Francis Galton

53. Forensic psychiatry is most commonly utilized in the criminal justice system to evaluate:
(A) Defendant competency to stand trial and legal insanity
(B) The general physical health and medical needs of inmates in a correctional facility
(C) The psychological profiling of consumer purchasing patterns and buying habits
(D) The detailed chemical composition and

synthesis of psychotropic drugs

54. When viscera is sent to the FSL after a suspected poisoning death, it is analyzed in which specific division?
(A) Forensic Biology Division
(B) Forensic Pathology Division
(C) Forensic Serology Division
(D) Toxicology Division

55. The analysis of hair and fiber evidence using microscopic techniques is traditionally categorized under which division of a forensic laboratory?
(A) Forensic Chemistry
(B) Forensic Biology
(C) Forensic Odontology
(D) Forensic Toxicology

56. Examination of erased chassis and engine numbers on a stolen vehicle involves chemical etching processes. Which division of the FSL typically conducts this examination?
(A) Chemistry
(B) Biology
(C) Physics
(D) Document

57. The full form of BPR&D, an important institution in Indian police and forensic administration, is:
(A) Bureau of Penal Research and Development
(B) Board of Police Reforms and Deployment
(C) Bureau of Prosecution and Rightful Defense
(D) Bureau of Police Research and Development

58. An investigating officer retrieves a handwritten suicide note and wants to know if it matches the diary entries of the deceased. This exhibit must be forwarded to which division?
(A) Questioned Documents
(B) Forensic Psychology Division
(C) Fingerprint Bureau
(D) Forensic Chemistry

59. The widely accepted fingerprint classification system used by the Central Finger Print Bureau in India to systematically file and retrieve ten-digit fingerprint cards is based on the system developed by:
(A) Dr. Juan Vucetich of Argentina
(B) Sir Edward Richard Henry
(C) Alphonse Bertillon of France
(D) Dr. Edmond Locard of France

60. A forensic botanist is examining a piece of wood attached to a suspected murder weapon. What specific characteristic of the wood will they analyze to determine its species?
(A) The extracted nuclear DNA profile of the victim found on the wood
(B) Microscopic cellular structure and xylem vessels
(C) The overall chemical composition of the surface varnish on wood
(D) The precise overall mass weight and measured density gradient alone

61. In cases involving suspected explosive devices, the post-blast residue must be sent to which FSL division for chemical characterisation?
(A) Forensic Chemistry
(B) Forensic Ballistics
(C) Forensic Physics
(D) Forensic Toxicology

62. Which instrument is indispensable in a Forensic Ballistics laboratory for observing the microscopic striae on two bullets simultaneously side-by-side?
(A) Scanning Electron Microscope
(B) Phase Contrast Microscope
(C) Comparison Microscope
(D) Stereo Zoom Microscope

NODIA

63. Under the NDPS Act, suspected samples of heroin or cocaine seized by the Uttar Pradesh Police are analyzed by the FSL to confirm their identity. This analysis is conducted by the:
(A) Forensic Biology and DNA Division
(B) Forensic Physics and Ballistics Division
(C) Forensic Serology and Fluid Division
(D) Forensic Chemistry Division

64. In a polygraph examination, a pneumograph tube is placed around the subject's chest to measure which specific physiological parameter?
(A) Cardiovascular heart rate and pulse
(B) Electrodermal galvanic skin response
(C) Respiration rate and depth
(D) Relative arterial blood pressure

65. The landmark 2010 Supreme Court of India judgment (Selvi v. State of Karnataka) ruled on the legal status of which forensic techniques?
(A) Forensic DNA Fingerprinting and Serological Testing
(B) Polygraph, Narco-analysis, and Brain Mapping

(C) Acoustic Voice Spectrography and Podiatric Gait Analysis
(D) Digital Cyber Forensics and Mobile Call Detail Records

66. The oldest Questioned Document examination setup in India was established in 1904 at which of the following locations?
(A) Kolkata
(B) Hyderabad
(C) Delhi
(D) Shimla

67. The central mandate of the Directorate of Forensic Science Services (DFSS) includes:
(A) Formulating policies and promoting forensic R&D
(B) Conducting regular armed police patrols across international border areas
(C) Providing close-proximity personal security to high-risk VIPs
(D) Managing and supervising all central and state prisons in the country

68. Age estimation from dentition is a critical task. Which of the following formulas/methods is most commonly utilized by forensic odontologists for age estimation in children?
(A) Gustafson's Method
(B) Trotter and Gleser Method
(C) Demirjian's Method
(D) Kastle-Meyer Method

69. DNA profiling, an advanced technique for individualization, falls broadly under the umbrella of which forensic discipline?
(A) Forensic Biology
(B) Forensic Chemistry and Explosives
(C) Forensic Toxicology and Pharmacology
(D) Forensic Pathology and Autopsy

70. Toolmarks found on a broken safe at a burglary scene are cast and sent to the laboratory. Which division will examine these toolmarks?
(A) Questioned Documents
(B) Forensic Chemistry
(C) Forensic Ballistics
(D) Forensic Physics

71. The National Automated Fingerprint Identification System (NAFIS) was conceptualized and is managed by which of the following agencies?
(A) NFSU
(B) NCRB
(C) BPR&D
(D) CBI

72. The duty of the 'First Responder' (usually the beat constable or patrol officer) at a crime scene includes all of the following EXCEPT:
(A) Providing immediate emergency medical assistance to injured victims
(B) Securing and isolating the crime scene perimeter with barricade tape
(C) Testing biological evidence at the scene
(D) Detaining potential eye-witnesses and suspects present at the location

73. Which of the following reagents is used as a presumptive color test for the presence of blood at a crime scene, turning pink in the presence of hemoglobin?
(A) Marquis Presumptive Color Reagent
(B) Dragendorff's Alkaloid Test Reagent
(C) Mandelin Quantitative Color Reagent
(D) Kastle-Meyer Reagent

74. Gait analysis, a component of forensic podiatry, is the study of:
(A) An individual's unique walking or running style
(B) The distribution and trajectory of blood spatter on physical walls
(C) The specific tread wear patterns present on the outer sole of a tire
(D) The anatomical alignment and impression of teeth in human bite marks

75. The post-mortem cooling of the body, a physical change used to estimate the time since death, is scientifically termed:
(A) Rigor mortis
(B) Algor mortis
(C) Livor mortis
(D) Pallor mortis

76. A Forensic Accounting expert would be most relevant in investigating which of the following offenses?
(A) Homicide committed using a high-caliber firearm
(B) Corporate fraud and embezzlement
(C) Intentionally set arson and structural sabotage
(D) Online cyberbullying and criminal defamation

Downloaded from www.pdf.tube

77. Wildlife forensics in India is crucial for prosecuting offenses committed under which major piece of legislation?
(A) The Wildlife (Protection) Act, 1972
(B) The Environment (Protection) Act, 1986
(C) The Indian Forest Act, 1927
(D) The Biological Diversity Act, 2002

78. When viscera is collected during an autopsy for toxicological analysis, which of the following is most commonly used as a general preservative?
(A) Aqueous formaldehyde solution (10% Formalin)
(B) Concentrated aqueous hydrogen peroxide solution
(C) Saturated solution of common salt
(D) Buffered glutaraldehyde chemical preservative

79. The primary use of identifying blowfly (Calliphoridae) larvae species and their developmental stage on a cadaver in Forensic Entomology is to estimate the:
(A) Exact cause of death
(B) Victim's blood group
(C) Toxicological profile of the victim
(D) Post-Mortem Interval (PMI)

80. A regional forensic science laboratory (RFSL) serves specific districts to reduce the case burden on the State FSL. Which of the following is a major RFSL in western Uttar Pradesh?
(A) RFSL Ayodhya
(B) RFSL Jhansi
(C) RFSL Agra
(D) RFSL Chitrakoot

81. The chief objective of a State Forensic Science Laboratory is to:
(A) Secure convictions of suspects strictly based on initial police theories
(B) Provide scientific evidence evaluation for justice delivery
(C) Offer long-term medical and social rehabilitation to crime victims
(D) Direct the prosecution of accused criminals in sessions court

82. In legal and forensic pathology terms, 'Exhumation' refers to:
(A) The long-term chemical preservation of internal organs in formalin
(B) The systematic destruction of biological evidence following a trial
(C) The detailed microscopic examination of histological tissue sections
(D) Exhuming a buried body for legal examination

83. The analysis of RAM (Random Access Memory) dumps, hard drive imaging, and hashing of digital evidence are standard operating procedures in which domain?
(A) Cyber and Digital Forensics
(B) Forensic Physics and Instrumentation
(C) Forensic Acoustics
(D) Forensic Psychiatry

84. In Narco-analysis, a barbiturate drug is administered intravenously to lower the subject's inhibitions. The most commonly used drug for this purpose is:
(A) Morphine sulfate
(B) Diazepam
(C) Sodium pentothal
(D) Ketamine

85. The world's first formal Fingerprint Bureau was established in 1897 in which Indian city?
(A) Kolkata (Calcutta)
(B) Chennai (formerly Madras)
(C) Mumbai (Bombay)
(D) New Delhi

86. Which Indian forensic scientist developed the Brain Electrical Oscillation Signature (BEOS) profiling technique?
(A) Dr. V. K. Kashyap
(B) Dr. Chandrashekhar
(C) Dr. P. C. Chatterjee
(D) Dr. C. R. Mukundan

NODIA

87. For an accurate estimation of Blood Alcohol Concentration (BAC) in a living subject suspected of drunk driving, which body fluid provides the most direct and legally sound toxicological evidence?
(A) Excreted Urine
(B) Venous Blood
(C) Oral Saliva
(D) Perspiration Sweat

88. A set of highly decomposed skeletal remains is found in a forest. Which forensic expert is best qualified to determine if the bones are human or animal, and to construct a biological profile?
(A) Forensic Odontology Expert
(B) Forensic Toxicology Expert
(C) Forensic Anthropologist

(D) Forensic Psychiatry Expert

89. Under the prevailing Indian criminal procedure codes, an inquest into an unnatural death is primarily conducted by the police or an executive magistrate under which section of the Code of Criminal Procedure?
(A) Section 154
(B) Section 164
(C) Section 313
(D) Section 174

90. The foremost reason why any break in the 'chain of custody' is detrimental to a criminal case is because:
(A) It raises doubt on evidence integrity in court
(B) The forensic laboratory will automatically refuse to process or analyze the sample
(C) It significantly delays the formal filing of the police First Information Report
(D) The physical evidence will rapidly undergo chemical degradation without custody forms

www.nodia.in

Click Here to Buy book on Amazon

ANSWERS

1. (B) Dactyloscopy
Dactyloscopy is the scientific discipline dedicated to the study, analysis, and classification of friction ridge patterns found on human fingers for personal identification. Because friction ridges remain unchanged throughout a person's life and display unique individual characteristics, this method serves as an indispensable tool in criminal investigations and forensic science for establishing conclusive human identity.

2. (D) The post-mortem interval (time since death)
Forensic entomology involves the study of insects and arthropods associated with decomposing remains in medicolegal investigations. By examining the succession patterns of colonizing insects and measuring the developmental stages of insect larvae gathered from a cadaver, forensic entomologists can reliably estimate the post-mortem interval, which represents the minimum elapsed time between death and body discovery.

3. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Rifling consists of helical grooves cut into the interior surface of a firearm barrel, creating raised lands and depressed grooves. As a bullet passes down the barrel during discharge, these spiral grooves force the projectile to spin along its longitudinal axis. This gyroscopic spin stabilizes the projectile in flight, preventing tumbling and maintaining aerodynamic stability.

4. (C) Blood, semen, saliva, and other body fluids
The forensic serology division specializes in the detection, identification, and characterization of biological body fluids collected from crime scenes. Laboratories employ presumptive and confirmatory biochemical tests to analyze physiological fluids including blood, seminal fluid, saliva, sweat, and vaginal secretions. These analyses provide critical evidentiary linkages between victims, suspects, and crime scene locations prior to detailed DNA analysis.

5. (A) Species identification from skeletal remains
The Forensic Chemistry division focuses on analyzing non-biological chemical matrices, including petroleum hydrocarbons, controlled substances, toxic substances, and chemical trap washings. Conversely, species identification from skeletal remains falls under forensic anthropology and forensic biology. Anthropologists and biologists examine osteological morphology, histological structure, and molecular composition to identify skeletal origins, placing such examinations entirely outside forensic chemical divisions.

6. (A) I and II only
Forensic odontology involves the application of dental science to legal investigations. Dental experts evaluate developmental eruption patterns and calcification stages of teeth to estimate biological age, while also analyzing bite mark evidence found on crime victims or physical objects. Microscopic examination of hair cuticles falls under forensic biology rather than dental forensic discipline, making hair examination irrelevant to odontology.

NODIA

7. (A) P-4, Q-1, R-2, S-3
Forensic laboratories divide physical evidence among specialized units according to scientific disciplines. Forensic Physics analyzes inert physical traces like glass fragments and soil samples. Forensic Toxicology isolates and identifies poisons and chemical substances within biological viscera. Forensic Ballistics examines firearms, cartridges, and bullet striae. Forensic Biology evaluates botanical matter, micro-organisms like diatoms, and biological evidence to support legal investigations.

8. (C) Digital and Cyber Forensics
Digital and Cyber Forensics deals with the identification, extraction, preservation, and analysis of electronically stored information. Specialists in this domain retrieve deleted electronic files, extract call detail records from telecommunication databases, reverse-engineer malicious software code, and analyze digital artifacts from computer hardware, mobile phones, and network devices to present admissible electronic evidence in legal proceedings.

9. (D) Forensic Physics
The Forensic Physics division examines physical evidence using principles of physical optics, mechanics, and material science. Measuring physical properties like the refractive index of glass fragments using oil immersion techniques and conducting soil density gradient tube analyses are fundamental physical methods used to compare crime scene exhibits with known control standards for criminal investigations.

10. (A) 2, 1, 4, 3
Evidence workflow in a forensic laboratory follows a systematic administrative and technical process. Sealed evidence exhibits arrive first at the central receiving section. Once registered, exhibits are formally allotted to appropriate scientific divisions. Expert analysts perform systematic scientific tests and instrumental analyses. Finally, experts prepare comprehensive forensic reports, which are dispatched to investigating agencies.

11. (B) Deciphering indented writings on paper
The Electrostatic Detection Apparatus is a specialized, non-destructive device used in questioned document laboratories to visualize latent indented writing impressions on paper. When writing occurs on an upper sheet, pressure creates invisible mechanical depressions on underlying sheets. The apparatus applies an electrostatic charge and toner powder to reveal these hidden indentations clearly without damaging the original document.

12. (B) The study of pollen and spores
Forensic palynology represents the application of pollen and spore analysis to legal matters and criminal investigations. Because microscopic botanical particles like pollen grains and fungal spores possess durable outer walls and unique microscopic structures specific to geographical regions and flowering seasons, analyzing palynomorphs found on clothing or suspects links individuals directly to specific geographic locations.

13. (A) To determine the cause, manner, and mechanism of death
A medico-legal autopsy performed by a certified forensic pathologist serves as a comprehensive post-mortem surgical examination of a deceased individual. The fundamental objective is establishing the official cause of death, determining the natural or unnatural manner of death, identifying physiological mechanisms leading to death, estimating post-mortem intervals, and gathering physical evidence for judicial proceedings.

14. (D) I, II, III, and IV
Forensic anthropology constructs biological profiles from skeletonized remains. Pelvic morphology offers the highest accuracy for sex determination due to childbearing adaptations. Long bones like the femur enable stature estimation through regression equations. Cranial suture closure patterns assist age estimation, while cranial features such as nasal aperture shape provide valuable indicators for ancestry estimation in forensic contexts.

15. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
A chain of custody is a chronological written record tracking the seizure, custody, transfer, analysis, and disposition of physical evidence. Legal integrity depends on demonstrating that evidence remained secure, unaltered, and free from contamination from collection to trial. Documenting every handling individual validates evidence authenticity and satisfies legal requirements for court admissibility.

16. (C) Ministry of Home Affairs
The Directorate of Forensic Science Services functions as the premier nodal administrative agency for forensic science affairs in India. Operating directly under the administrative jurisdiction of the Ministry of Home Affairs, Government of India, this apex central organization coordinates forensic laboratory standards, oversees infrastructure modernization, and promotes advanced forensic research initiatives across various scientific institutions.

17. (B) Kolkata
India's first Central Forensic Science Laboratory was formally established in 1957 at Kolkata. Set up to provide advanced scientific examination facilities and expert assistance to law enforcement agencies across the country, this historic institution marked the beginning of modern centralized forensic laboratory infrastructure in post-independence India, supporting criminal investigations with specialized scientific divisions.

Downloaded from www.pdf.tube

18. (A) I and II only
The National Forensic Sciences University was established by an Act of Parliament as an Institution of National Importance, with its headquarters located in Gandhinagar, Gujarat. Although dedicated to forensic education and research, the university operates under the Ministry of Home Affairs rather than the Ministry of Education, making the administrative ministry statement incorrect.

19. (A) P-1, Q-2, R-3, S-4
Major forensic and criminal justice institutions in India operate across distinct geographic locations. The Central Fingerprint Bureau and LNJN National Institute of Criminology and Forensic Science are located in New Delhi. The National Forensic Sciences University maintains its primary headquarters in Gandhinagar, Gujarat. The Uttar Pradesh State Forensic Science Laboratory operates out of Lucknow.

20. (C) To modernise police forces and facilitate research in forensic science
The Bureau of Police Research and Development was established in 1970 under the Ministry of Home Affairs to modernize police administration in India. Its chief objective is identifying emerging police training needs, promoting research into crime trends and policing techniques, and facilitating technological advancement and forensic science capabilities across police forces nationwide.

21. (A) Mathura
The Directorate of Forensic Science in Uttar Pradesh manages regional laboratories to handle evidentiary caseloads from police zones across the state. Regional Forensic Science Laboratories operate in major administrative cities such as Agra, Varanasi, Moradabad, and Lucknow. Mathura does not host a Regional Forensic Science Laboratory, relying instead on nearby regional facilities.

22. (D) Central Forensic Science Laboratories
Government Examiner of Questioned Documents institutions were historically independent government setups tasked with analyzing handwriting, signatures, and document alterations. To streamline forensic administration in India, GEQD offices located in places like Shimla, Kolkata, and Hyderabad were structurally integrated into Central Forensic Science Laboratories under the administrative control of the DFSS.

23. (A) Director → Joint Director → Deputy Director → Scientific Officer
State Forensic Science Laboratories maintain a structured organizational hierarchy for operational leadership and scientific management. The Director serves as the apex administrative and technical head, followed hierarchically by Joint Directors supervising major wings, Deputy Directors managing technical divisions, Senior Scientific Officers, and Scientific Officers who conduct direct laboratory examination of forensic evidence exhibits.

24. (C) National Crime Records Bureau (NCRB)
The Central Finger Print Bureau functions directly under the administrative control of the National Crime Records Bureau in New Delhi, India. The bureau serves as the central national repository for criminal fingerprint records, managing automated database systems, standardizing classification techniques, and providing continuous technical support to law enforcement agencies across all Indian states.

25. (D) Barefoot prints, footwear, and gait patterns
Forensic podiatry is a specialized sub-discipline involving the application of podiatric medical knowledge to criminal investigations. Practitioners evaluate barefoot impressions, footwear characteristics, wear patterns on shoes, and individual human gait dynamics captured on surveillance videos to assist law enforcement agencies in linking suspects to specific physical evidence found at crime scenes.

NODIA

26. (A) Pitch, formants, and frequency distributions
Acoustic voice analysis and speaker identification rely on spectrographic evaluation of audio recordings to compare unknown recorded voices against known exemplar samples. Primary acoustic parameters measured include fundamental frequency, vocal pitch variations, formant frequencies, harmonic distribution patterns, and temporal dynamics, which together reflect the unique anatomical structure and speech habits of a speaker.

27. (B) I, II, and IV only
Polygraphs record autonomic physiological responses like pulse, respiration, and galvanic skin conductance. Narco-analysis uses intravenous

barbiturates like sodium pentothal to induce a hypnotic state. The Indian Supreme Court ruled unconsented administration of polygraph, narco-analysis, and BEOS unconstitutional. BEOS measures non-verbal electroencephalographic responses rather than requiring verbal answers, rendering statement III incorrect.

28. (B) To care for trauma victims while gathering medico-legal evidence
Forensic nursing bridges medical healthcare delivery and the legal justice system. Forensic nurses provide specialized clinical care, trauma support, and immediate compassionate intervention to victims of violence, sexual assault, and abuse, while simultaneously collecting crucial biological evidence, documenting acute physical injuries, maintaining chain of custody, and testifying as expert witnesses in court proceedings.

29. (A) Wildlife Institute of India, Dehradun
The Wildlife Institute of India, located in Dehradun, Uttarakhand, serves as a premier autonomous institution in wildlife research and conservation. Possessing specialized wildlife forensic capabilities, the institute regularly assists law enforcement agencies by analyzing confiscated biological exhibits such as animal skins, bones, claws, ivory, and meats to identify poached species in wildlife crime cases.

30. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Forensic linguistics applies scientific linguistic analysis to legal investigations, including authorship attribution for disputed or anonymous texts like threat letters. Every individual develops a unique personal dialect, termed an idiolect, characterized by distinctive subconscious patterns in syntax, vocabulary preference, spelling, and grammar. Analyzing these stylistic markers allows forensic experts to link written documents to specific authors.

31. (D) Recover human remains and buried physical evidence
Forensic archaeology involves adapting standard archaeological excavation techniques, spatial mapping, and stratigraphy principles to medico-legal death investigations. Practitioners assist law enforcement agencies by locating clandestine graves, excavating buried human remains systematically, documenting surface scatter, and recovering associated physical evidence without compromising site integrity or destroying delicate context needed for court trials.

32. (C) Forensic Accounting
Forensic accounting integrates accounting principles, auditing procedures, and investigative techniques to evaluate financial records for legal proceedings. Forensic accountants analyze complex financial transactions to detect corporate fraud, uncover embezzlement schemes, trace illicit money flows in money laundering operations, and reconstruct concealed financial records to provide expert testimony in civil and criminal litigation.

33. (A) P-3, Q-1, R-4, S-2
Forensic sub-disciplines utilize specific analytical methods tailored to evidence types. Forensic Botany uses diatom analysis from tissue samples to evaluate drowning cases. Forensic Serology employs the Kastle-Meyer color test to detect blood traces. Forensic Toxicology uses Thin Layer Chromatography to isolate toxic substances. Forensic Ballistics utilizes comparison microscopes to match microscopic striae on bullets.

34. (D) Ante-mortem drowning
Diatom testing is a established forensic pathology procedure for confirming ante-mortem drowning. When a living victim drowns, microscopic unicellular algae called diatoms present in the water enter the lungs, pass through damaged alveolar walls into pulmonary circulation, and deposit in closed organs like bone marrow. Detecting identical diatom species in bone marrow confirms active inhalation while alive.

35. (A) Section 45
Under Bharatiya Sakshya Adhiniyam, 2023 (corresponding to Section 45 of the former Indian Evidence Act, 1872), the opinions of experts upon points of foreign law, science, art, or identity of handwriting or finger impressions are considered relevant facts. This legal provision authorizes courts to admit scientific testimony and evaluation reports from qualified forensic experts.

36. (A) 2, 1, 4, 3
Crime scene management by first responders follows an established operational hierarchy to preserve evidence integrity. Securing and

Click Here to Buy book on Flipkart

isolating the crime scene perimeter prevents unauthorized contamination. Next, documenting the scene through photographs and rough sketches captures spatial relationships. Officers then conduct a systematic physical search for exhibits, concluding with safe packaging, sealing, and labeling of collected evidence.

37. (A) Subpoena (Summons)
A subpoena or court summons is a formal legal writ issued by a judicial officer commanding a named individual to appear at a specified time and place to give testimony or produce evidence. When forensic experts complete lab reports, courts issue subpoenas compelling their personal presence in court to present expert evidence and undergo cross-examination.

38. (B) I and III only
A forensic expert testifying in court acts as an impartial scientific advisor to the judiciary rather than an advocate for either prosecution or defense. Before providing expert opinion, the witness must formally establish professional qualifications and credentials. Once admitted as an expert, their findings and methodologies are subjected to detailed cross-examination by defense counsel.

39. (B) Ballistics Division
The Ballistics Division of a Forensic Science Laboratory is dedicated strictly to analyzing physical evidence related to firearms, ammunition components, bullet trajectories, toolmark striae, and propellants. Biological fluid analysis and short tandem repeat DNA profiling fall exclusively under the operational domains of Serology, Biology, and DNA divisions, making Ballistics completely uninvolved in biological fluids.

40. (C) Prevent contamination and maintain chain of custody
Meticulously packaging, tamper-proof sealing, and obtaining independent witness signatures on physical evidence at crime scenes serves vital legal and scientific functions. Proper sealing prevents environmental degradation, deliberate tampering, or accidental cross-contamination. Witness signatures verify original recovery conditions, establishing an unbroken chain of custody necessary to satisfy court admissibility criteria during judicial proceedings.

41. (D) Provide immediate scientific support at crime scenes
Mobile Forensic Science Laboratories are specially equipped, custom-designed vehicles deployed directly to major crime scenes. Equipped with preliminary chemical test kits, specialized light sources, photo-documentation tools, latent fingerprint development gear, and trace packaging supplies, these units enable forensic experts to provide immediate scientific evaluation, evidence search assistance, and field documentation support to investigating officers.

42. (A) New Delhi
The Lok Nayak Jayaprakash Narayan National Institute of Criminology and Forensic Science is situated in Sector 3, Rohini, New Delhi. Functioning under the Ministry of Home Affairs, this premier academic and training establishment provides specialized post-graduate education, inter-disciplinary research opportunities, and comprehensive training programs for judiciary officers, police personnel, and forensic scientists across India.

43. (B) Pre-test interview → In-test phase → Chart analysis → Post-test interview
A standard polygraph examination follows a structured sequential protocol. The examiner begins with a pre-test interview to explain procedures and formulate questions. The in-test phase collects physiological data while administering questions. The examiner then performs detailed chart analysis of recorded polygraph tracings, concluding with a post-test interview to discuss diagnostic results or clear ambiguities.

44. (B) NCRB
The National Crime Records Bureau operating under the Ministry of Home Affairs is tasked with compiling national crime statistics and publishing the annual Crime in India report. NCRB also conceptualized, deployed, and manages the National Automated Fingerprint Identification System, a centralized biometric repository connecting law enforcement agencies nationwide for rapid fingerprint identification.

45. (A) Lucknow
The headquarters of the Uttar Pradesh State Forensic Science Laboratory is located in Mahanagar, Lucknow. Serving as the principal apex laboratory in Uttar Pradesh, this facility

Downloaded from www.pdf.tube

houses specialized divisions including Forensic Chemistry, Toxicology, Physics, Ballistics, Biology, Serology, DNA Profiling, Questioned Documents, and Cyber Forensics to support criminal investigations across the state.

46. (C) III only
Brain Electrical Oscillation Signature profiling is a non-invasive, neuro-psychological technique developed to detect experiential knowledge present in a subject's brain. The test utilizes a sensor cap with surface electrodes placed on the scalp to monitor event-related electrical potentials, specifically P300 waves. Surgical implantation of electrodes is completely unnecessary, making statement III incorrect.

47. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Monozygotic twins develop from a single fertilized egg, giving them identical nuclear DNA sequences and matching genetic profiles. However, their fingerprint ridge patterns are distinct. Friction ridge morphogenesis in utero is governed by random micro-environmental variables, such as differential amniotic fluid pressure, umbilical cord length, and cellular growth forces, ensuring unique fingerprint characteristics for every human.

48. (A) I, II, and III only
Video Spectral Comparators utilize multi-spectral illumination to differentiate ink compositions non-destructively. Microscopy reveals pen pauses and tremors indicative of traced forgery. Paper features provide key forensic characteristics. However, Thin Layer Chromatography requires micro-sampling ink from paper using a punch, making TLC a micro-destructive technique rather than a non-destructive test, rendering statement IV incorrect.

49. (A) P-3, Q-2, R-4, S-1
Uttar Pradesh police forensic administration operates through hierarchical structural units. State FSL Headquarters in Lucknow functions as the apex research and analytical facility. Cyber Crime Police Stations serve as state-level nodal centers for high-tech digital crimes. Regional FSL Agra provides specialized analytical services for western UP districts, while District Field Units gather basic crime scene evidence.

50. (D) Soil, minerals, and rock samples
Forensic geology evaluates earth materials collected in legal contexts. Geological specialists examine physical and chemical properties of soil, mineral grains, rock fragments, micro-fossils, and construction materials attached to suspects' shoes, tools, or vehicles to compare them with site samples, thereby establishing physical linkages between suspects, physical evidence, and specific crime scene geographic locations.

51. (A) Forensic Engineering
Forensic engineering applies engineering principles, material analysis, and physics dynamics to legal investigations. Practitioners examine structural failures, building collapses, component defects, industrial explosions, fires, and vehicle collisions. By analyzing stress mechanics, impact dynamics, and material fatigue, forensic engineers reconstruct failure sequences and determine root causes for legal proceedings and insurance disputes.

52. (C) Hans Gross
Hans Gross, an Austrian magistrate and legal scholar, is universally regarded as the Father of Criminalistics. In 1893, he published his ground-breaking treatise titled Handbuch für Untersuchungsrichter (Manual for Examining Magistrates), which systematically integrated scientific disciplines, including physics, chemistry, botany, zoology, and microscopy, into the practical realm of criminal investigation and evidence collection.

NODIA

53. (A) Defendant competency to stand trial and legal insanity
Forensic psychiatry operates at the intersection of mental health medicine and judicial jurisprudence. Forensic psychiatrists perform specialized clinical evaluations on defendants to assess their mental state at the time of an offense (determining legal insanity) and evaluate present cognitive capacity to understand courtroom proceedings and assist counsel, thereby establishing legal competency to stand trial.

54. (D) Toxicology Division
Viscera samples, including preserved internal organs, body fluids, and stomach contents collected during autopsies in suspected poisoning cases, are forwarded directly to the Forensic Toxicology Division. Toxicologists use advanced analytical separation and detection techniques

like gas chromatography and mass spectrometry to isolate, identify, and quantify toxic chemical agents or drugs within organic tissue matrices.

55. (B) Forensic Biology
Microscopic examination of trace biological evidence, such as human and animal hairs or natural biological fibers, falls under the Forensic Biology division. Forensic biologists utilize comparison light microscopy and stereomicroscopy to examine structural features including hair cuticle scales, medullary indices, pigmentation patterns, and cross-sectional morphology to characterize and compare recovered hair and fiber samples.

56. (C) Physics
The restoration of erased or obliterated chassis numbers and engine serial markings on stolen motor vehicles is conducted by the Forensic Physics division. Chemical etching reagents are applied to metallic surfaces where stamped digits altered crystalline structures beneath impressions. The higher acid dissolution rate of stressed metal restores original serial numbers through physical contrast visual development.

57. (D) Bureau of Police Research and Development
BPR&D stands for the Bureau of Police Research and Development, an essential nodal organization functioning under the Union Ministry of Home Affairs in India. Established in 1970, BPR&D promotes operational modernization across state police forces, conducts empirical research on crime trends, evaluates law enforcement technology, and strengthens nationwide forensic science training and infrastructural development.

58. (A) Questioned Documents
Questioned handwritten notes, suicide letters, and personal diary entries require forensic analysis in the Questioned Documents division. Forensic document examiners utilize microscopic and side-by-side comparative analysis to evaluate individual handwriting characteristics, slant, stroke structure, pen pressure, line quality, and spatial arrangement to determine whether the suicide note was written by the same individual who wrote the diary.

59. (B) Sir Edward Richard Henry
The fingerprint classification system used by fingerprint bureaus across India and worldwide was developed by Sir Edward Richard Henry in the late nineteenth century, assisted by Azizul Haque and Hem Chandra Bose in Bengal. The Henry Classification System categorizes ten-print fingerprint cards based on pattern types—loops, whorls, and arches—enabling systematic manual filing and efficient retrieval.

60. (B) Microscopic cellular structure and xylem vessels
Forensic botanical examination of wood evidence focuses on comparative anatomical features viewed under optical microscopy. Botanical experts slice thin sections of wood to examine diagnostic microscopic cellular arrangements, including xylem vessel distribution, ray parenchyma structures, tracheid dimensions, and annual growth ring characteristics, allowing definitive identification of the botanical species and comparison with control timber samples.

61. (A) Forensic Chemistry
Post-blast residues collected from explosion sites undergo chemical characterization within the Forensic Chemistry division. Forensic chemists extract unburned energetic residues and chemical degradation products, performing instrumental techniques like Gas Chromatography-Mass Spectrometry and Ion Chromatography to identify organic and inorganic explosive ingredients, thereby providing critical evidence regarding the explosive device composition.

62. (C) Comparison Microscope
A comparison microscope is an essential optical instrument in forensic ballistics, consisting of two individual microscopes joined by an optical bridge. This design allows ballistics experts to view two separate objects, such as a crime scene bullet and a test-fired bullet, side-by-side in a single split-screen field of view to match microscopic striations.

63. (D) Forensic Chemistry Division
Seized narcotic drugs and psychotropic substances collected under the NDPS Act are analyzed by the Forensic Chemistry Division. Forensic chemists conduct preliminary color tests followed by sophisticated chromatographic and spectroscopic analyses, such as High-Performance Liquid Chromatography and Gas Chromatography-Mass Spectrometry, to confirm substance identity, purity levels, and controlled chemical classification for judicial prosecution.

Click Here to Buy book on Amazon

64. (C) Respiration rate and depth
During a polygraph examination, a pneumograph tube is strapped securely around the examinee's chest and abdominal region. The flexible corrugated tube expands and contracts with bodily movements during breathing cycles, transmitting air pressure changes to recording sensors to continuously measure and record respiratory rate, breathing patterns, and inhalation depth during question administration.

65. (B) Polygraph, Narco-analysis, and Brain Mapping
In Selvi v. State of Karnataka (2010), the Supreme Court of India delivered a landmark judgment regarding involuntary neuro-scientific tests. The apex court ruled that administering polygraph tests, narco-analysis, and brain mapping profiling without explicit informed consent violates constitutional guarantees against self-incrimination under Article 20(3) and the right to personal liberty under Article 21.

66. (D) Shimla
The earliest official questioned document facility in India was established in 1904 at Shimla under the name Government Examiner of Questioned Documents. Created to inspect handwriting and disputed documents for the British Indian government, this historic establishment laid the groundwork for specialized document examination laboratories, which were eventually integrated into Central Forensic Science Laboratories across India.

67. (A) Formulating policies and promoting forensic R&D
The Directorate of Forensic Science Services functions as the central administrative nodal agency under the Ministry of Home Affairs to oversee forensic science advancement in India. Its primary mandate involves formulating national forensic policies, setting quality standards, coordinating forensic research and development, modernizing laboratory infrastructure, and organizing specialized technical training for forensic personnel nationwide.

68. (C) Demirjian's Method
Demirjian's method is a widely accepted dental age estimation technique in forensic odontology, specifically designed for pediatric and juvenile individuals. The system assesses seven mandibular teeth on panoramic radiograph views, assigning scores based on developmental calcification stages of tooth crowns and roots to calculate a total maturity score converted into estimated biological age.

69. (A) Forensic Biology
DNA profiling is a specialized molecular sub-discipline categorized under the broader field of Forensic Biology. Biologists extract deoxyribonucleic acid from biological stains such as blood, semen, saliva, hair roots, or tissues recovered at crime scenes, analyzing polymorphic short tandem repeat loci to generate unique genetic profiles for individual identification and paternity testing.

70. (D) Forensic Physics
Physical toolmarks, impression casts, mechanical striations, and physical matching of fractured metallic components fall under the domain of the Forensic Physics division. Forensic physicists examine cast impressions from broken safes, doors, or locks using comparison macroscopes to match microscopic class and individual features with suspect tools such as crowbars, chisels, or bolt cutters.

71. (B) NCRB
The National Automated Fingerprint Identification System is a national-level biometric database project conceptualized, implemented, and managed by the National Crime Records Bureau. NAFIS digitizes, stores, and processes ten-print cards and latent fingerprints collected from crime scenes, enabling rapid automated fingerprint search and matching capabilities for law enforcement officers across India.

NODIA

72. (C) Testing biological evidence at the scene
The primary duties of first responders at a crime scene focus on scene preservation and safety, including providing medical assistance to injured individuals, securing the scene perimeter, and detaining witnesses or suspects. Conducting laboratory forensic tests on biological evidence lies outside first responder duties and must be performed later by qualified scientists within controlled environments.

73. (D) Kastle-Meyer Reagent
The Kastle-Meyer test is a widely used presumptive chemical color test for identifying blood at crime scenes. The reagent contains

reduced phenolphthalein and potassium hydroxide. In the presence of hydrogen peroxide, the peroxidase-like activity of hemoglobin in blood oxidizes phenolphthalein back to its active form, producing an immediate characteristic pink color change.

74. (A) An individual's unique walking or running style
Gait analysis represents a key component of forensic podiatry and biomechanics, involving the systematic evaluation of human locomotion patterns. Experts examine video footage, force plate records, and footprint sequences to analyze step length, stride duration, foot angles, and body dynamics, helping establish unique individual walking or running styles for suspect identification in investigations.

75. (B) Algor mortis
Algor mortis refers to the post-mortem reduction in body temperature until ambient equilibrium is reached. Following death, metabolic heat production ceases, causing the body to cool gradually through radiation, conduction, and convection. Forensic pathologists measure rectal or hepatic core temperature to calculate cooling rates, providing vital estimates for establishing time since death.

76. (B) Corporate fraud and embezzlement
Forensic accounting is specifically designed to investigate financial crimes and economic misdeeds. Practitioners examine accounting ledgers, banking records, corporate tax filings, and transaction logs to uncover complex schemes such as corporate fraud, asset embezzlement, insider trading, and tax evasion, presenting clear financial analysis and findings suitable for legal prosecution in courts.

77. (A) The Wildlife (Protection) Act, 1972
Wildlife forensics in India plays an indispensable evidentiary role in enforcing the provisions of the Wildlife (Protection) Act, 1972. The Act prohibits poaching, illegal trade, and possession of scheduled wild animals or derived products. Forensic analysis identifies protected species from hair, bone, meat, or skin samples, establishing legal proof to convict wildlife offenders.

78. (C) Saturated solution of common salt
When internal viscera samples are collected during an autopsy for toxicological evaluation, a saturated solution of common salt (sodium chloride) is standardly used as a chemical preservative. Formalin is strictly avoided because it interferes with chemical isolation and destroys organic poisons, whereas saturated salt solution preserves tissue integrity without altering toxicological chemical targets.

79. (D) Post-Mortem Interval (PMI)
Forensic entomologists analyze insect evidence from cadavers to estimate post-mortem interval. Calliphoridae blowflies are typically the first insects to colonize a corpse. By determining blowfly larval species and measuring their age based on developmental stage and temperature-dependent growth rates, forensic experts establish the minimum time elapsed since human death occurred.

80. (C) RFSL Agra
Regional Forensic Science Laboratories are strategically situated across Uttar Pradesh to handle evidentiary cases from surrounding police districts. Regional FSL Agra serves as the primary regional forensic facility for western Uttar Pradesh, analyzing physical evidence, chemical exhibits, and biological samples to reduce casework loads on the central state headquarters in Lucknow.

81. (B) Provide scientific evidence evaluation for justice delivery
The chief objective of a State Forensic Science Laboratory is providing impartial, scientifically sound evaluation of physical evidence submitted by law enforcement and judicial authorities. State FSLs apply rigorous scientific principles and instrumental testing to provide objective forensic findings, aiding the criminal justice delivery system in determining factual truth in legal proceedings.

82. (D) Exhuming a buried body for legal examination
Exhumation refers to the lawful disinterment or unearthing of a previously buried human body for post-mortem legal examination. Conducted under judicial order or executive magistrate sanction, exhumations are performed when foul play is newly suspected, original autopsies were omitted, or fresh forensic issues require pathologically re-examining the remains for medico-legal investigation.

Downloaded from www.pdf.tube

83. (A) Cyber and Digital Forensics
Cyber and Digital Forensics handles the acquisition, extraction, and verification of volatile and non-volatile electronic data. Techniques like volatile RAM memory dumping, bit-stream forensic imaging of storage drives, and cryptographic hash verification safeguard digital artifact integrity, enabling cyber forensic experts to recover digital evidence admissible in modern criminal court trials.

84. (C) Sodium pentothal
Narco-analysis involves the controlled intravenous administration of a short-acting barbiturate, most commonly sodium pentothal (sodium thiopental). Known colloquially as truth serum, the drug depresses the central nervous system to induce a hypnotic, semi-conscious trance wherein the subject's inhibitions and cognitive capacity to fabricate lies are significantly reduced during detailed forensic interrogation.

85. (A) Kolkata (Calcutta)
The world's first official Fingerprint Bureau was established in June 1897 at Writers' Building in Kolkata (Calcutta), India. Developed under the initiative of Sir Edward Richard Henry alongside Indian sub-inspectors Azizul Haque and Hem Chandra Bose, the bureau pioneered systematic classification, recording, and matching of ten-digit criminal fingerprints for law enforcement.

86. (D) Dr. C. R. Mukundan
Brain Electrical Oscillation Signature profiling was developed by Indian neuro-psychologist Dr. C. R. Mukundan at the National Institute of Mental Health and Neurosciences in Bengaluru. The technique uses scalp sensors to record non-invasive electroencephalographic responses, identifying specific P300 event-related potentials indicative of experiential knowledge stored in the human brain during forensic investigations.

87. (B) Venous Blood
Venous blood serves as the gold standard biological specimen for quantitatively determining Blood Alcohol Concentration in living individuals. Unlike urine or breath tests, analyzing intact venous blood samples via Headspace Gas Chromatography provides direct, legally defensible, and accurate measurements of ethyl alcohol circulating within the metabolic vascular system at the time of sampling.

NODIA

88. (C) Forensic Anthropologist
Forensic anthropologists specialize in osteological examination of skeletonized, commingled, or severely decomposed human remains. By analyzing macro-morphological features and metrics of skeletal components, forensic anthropologists distinguish human bones from non-human animal bones and construct complete biological profiles incorporating sex, biological age at death, stature, population ancestry, and evidence of trauma.

89. (D) Section 174
Inquest proceedings into unnatural, suspicious, or violent deaths are conducted by police officers or executive magistrates under Section 174 of the Code of Criminal Procedure (or corresponding provisions in Bharatiya Nagarik Suraksha Sanhita). This statutory provision mandates investigating officers to inspect the body, note apparent injuries, determine probable causes, and record detailed inquest reports.

90. (A) It raises doubt on evidence integrity in court
Maintaining an unbroken chain of custody is essential for establishing legal integrity and court admissibility of physical evidence. Any undocumented transfer, missing log entry, or breach in custody control raises reasonable doubt regarding potential tampering, substitution, or contamination, compromising the overall evidentiary reliability of scientific findings during formal trial proceedings.

CHAPTER 03

Ethics, Quality Assurance and Standards of Admissibility

1. The primary ethical obligation of a forensic scientist during expert testimony is to serve as an advocate for:
(A) The prosecution or investigating agency
(B) The scientific evidence and the truth
(C) The defense attorney representing the accused
(D) The victim and the victim's family

2. Which of the following best differentiates Quality Assurance (QA) from Quality Control (QC) in a forensic laboratory?
(A) QA involves checking final reports, while QC involves writing the standard operating procedures
(B) QA is only performed by external auditors, while QC is only performed by laboratory directors
(C) QA deals exclusively with instrument calibration, while QC deals exclusively with personnel training
(D) QA is process-oriented and proactive, while QC is product-oriented and reactive

3. The international standard specifying the general requirements for the competence, impartiality, and consistent operation of testing and calibration laboratories is:
(A) ISO/IEC 17025
(B) ISO 9001
(C) ISO 14001
(D) ISO/IEC 27001

4. The 1923 landmark legal decision that established the "general acceptance" test for the admissibility of scientific evidence is:
(A) Daubert v. Merrell Dow Pharmaceuticals
(B) Kumho Tire Co. v. Carmichael
(C) Frye v. United States
(D) General Electric Co. v. Joiner

5. A forensic document examiner forms an initial theory about a forged signature and subsequently focuses only on the features that support this theory while ignoring structural differences. This is an example of:
(A) Confirmation bias
(B) Contextual bias
(C) Sequential unmasking
(D) Double-blind verification

6. The process of proving that an analytical method is acceptable for its intended purpose is known as:
(A) Method certification
(B) Method calibration
(C) Method proficiency
(D) Method validation

7. Which of the following is NOT one of the explicit factors outlined in the Daubert standard for assessing the reliability of scientific expert testimony?
(A) Whether the theory or technique has been tested
(B) The academic pedigree and university affiliation of the expert witness
(C) Whether the theory or technique has been subjected to peer review and publication
(D) The known or potential error rate of the method

8. In the context of Indian laboratory accreditation, the acronym NABL stands for:
(A) National Agency for Biometric and Laboratory testing
(B) National Authority for Basic and Laboratory sciences
(C) National Accreditation Board for Testing and Calibration Laboratories
(D) National Assessment Board for Legal evidence

9. Under Section 39 of the Bharatiya Sakshya Adhiniyam, 2023 (and Section 45 of the Indian Evidence Act, 1872), the opinions of experts are relevant facts when the Court has to form an opinion upon a point of:

Click Here to Buy book on Flipkart

(A) Matters of general public morality, social norms, and personal ethics
(B) The general character, reputation, and disposition of the accused
(C) Unverified hearsay statements provided by an independent third party
(D) Foreign law, science, art, handwriting, or finger impressions

10. Errors in analytical measurement that remain constant or vary in a predictable manner, often due to faulty calibration, are classified as:
(A) Systematic errors
(B) Random errors
(C) Gross errors
(D) Unavoidable errors

11. A forensic toxicologist is asked to analyze blood samples in a hit-and-run case where the accused is the toxicologist's cousin. Ethically, the toxicologist should:
(A) Analyze the sample but not mention the relationship
(B) Disclose the conflict of interest and recuse themselves from the case
(C) Analyze the sample and report the relationship only if the result is positive for alcohol
(D) Ask a subordinate to analyze the sample under the toxicologist's name

12. Consider the following statements regarding ISO/IEC 17025 accreditation:
I. It requires the laboratory to establish a system for metrological traceability.
II. It mandates that laboratories must only use non-standard, self-developed methods.
III. It requires the laboratory to have a procedure for evaluating measurement uncertainty.
Which combination of the above statements is correct?
(A) I and II only
(B) I and III only
(C) II and III only
(D) I, II, and III

13. An audit conducted by the laboratory's own trained personnel to ensure compliance with its quality management system is called a/an:
(A) Internal audit
(B) External audit
(C) Third-party audit
(D) Proficiency test

14. The evaluation of a laboratory's performance against pre-established criteria by means of inter-laboratory comparisons is known as:
(A) Blind case verification
(B) Analytical method validation
(C) Proficiency testing
(D) Corrective action plan

15. A fingerprint examiner is told by the investigating officer that the suspect has confessed to the crime before the examination begins. If this extraneous information influences the examiner's conclusion, it is an example of:
(A) Selection bias
(B) Measurement uncertainty
(C) Instrumental error
(D) Contextual bias

16. To ensure accuracy and traceability of an analytical instrument, a forensic laboratory should primarily use:
(A) Purified procedural reagent blanks
(B) Matrix-matched spiked control samples
(C) Certified Reference Materials (CRMs)
(D) Blinded unknown quality control samples

17. The US Supreme Court case that clarified that the Daubert gatekeeping role applies not only to scientific testimony but to all expert testimony (technical and other specialized knowledge) is:
(A) Frye v. United States
(B) Kumho Tire Co. v. Carmichael
(C) General Electric Co. v. Joiner
(D) Brady v. Maryland

NODIA

18. Read the given statements regarding chain of custody in forensic science and select the correct option.
Assertion (A): Maintaining a strict chain of custody is a critical quality assurance measure in forensic science.
Reason (R): A proper chain of custody ensures the integrity of the evidence by documenting every person who handled it, proving it has not been tampered with or substituted.
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A)
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A)
(C) Assertion (A) is true, but Reason (R) is false
(D) Assertion (A) is false, but Reason (R) is true

19. In quality control, a sample that contains no analyte of interest and is subjected to the same analytical procedure as the evidentiary sample is known as a:
(A) Blank sample
(B) Positive control
(C) Spiked sample
(D) Certified reference material

20. The primary purpose of a Standard Operating Procedure (SOP) in a forensic laboratory is to:
(A) Provide a comprehensive theoretical background and scientific principles of the method
(B) Summarize and document the final analytical results and findings of a forensic case
(C) Ensure consistency, reliability, and reproducibility in procedures
(D) Justify administrative resource allocation and divisional budget requirements

21. The severe ethical violation where an analyst reports results of laboratory analyses without ever having performed the tests is known as:
(A) Dry-labbing
(B) Cognitive bias
(C) Sequential unmasking
(D) Observer effect

22. Which of the following represents the correct chronological sequence of the landmark legal decisions known as the "Daubert Trilogy"?
(A) Daubert v. Merrell Dow → General Electric Co. v. Joiner → Kumho Tire Co. v. Carmichael
(B) General Electric Co. v. Joiner → Daubert v. Merrell Dow → Kumho Tire Co. v. Carmichael
(C) Kumho Tire Co. v. Carmichael → Daubert v. Merrell Dow → General Electric Co. v. Joiner
(D) Daubert v. Merrell Dow → Kumho Tire Co. v. Carmichael → General Electric Co. v. Joiner

23. A forensic expert bound by confidentiality may disclose case-related information to a third party only when:
(A) Requested by a media outlet covering a high-profile case
(B) Specifically authorized by law or by the client/court
(C) Discussing the case informally with colleagues from another unconnected laboratory
(D) The case has been reported in the local newspaper

NODIA

24. A process wherein a second examiner re-evaluates the evidence without knowing the first examiner's conclusion, and without knowing which case the evidence belongs to, is called:
(A) Single-blind case verification
(B) Proficiency testing
(C) Double-blind verification
(D) Peer-reviewed scientific publication

25. Consider the following statements regarding the Frye standard:
I. It requires the scientific community to broadly accept a method before it is admissible in court.
II. It designates the trial judge as the definitive "gatekeeper" who must weigh specific reliability factors.
III. It was established following a case involving a crude polygraph (systolic blood pressure deception test).
IV. It remains the prevailing standard in all Federal Courts in the United States today.
Which combination of the above statements is correct?
(A) I and II only
(B) I and III only
(C) II and IV only
(D) I, III, and IV only

26. A non-negative parameter characterizing the dispersion of the values being attributed to a measurand, based on the information used, is called:
(A) Measurement uncertainty
(B) Systematic analytical error
(C) Method limit of detection
(D) Gross experimental variance

27. Which of the following is the most effective statistical approach to mitigate the impact of random errors during quantitative forensic analysis?
(A) Routinely calibrating the measurement instrument against a certified primary standard
(B) Taking replicate measurements and calculating the mean
(C) Preparing and analyzing a procedural reagent blank alongside extraction
(D) Increasing the overall mass or volume of the evidential test material

28. Action taken to eliminate the cause of a potential nonconformity or other undesirable potential situation before it occurs is known as:
(A) Corrective action
(B) Preventive action
(C) Internal audit
(D) Root cause analysis

29. The operation that establishes a relation between the quantity values provided by measurement standards and the corresponding indications of an instrument is known as:
(A) Calibration
(B) Validation
(C) Verification
(D) Standardization

30. Match the legal cases in List I with their core legal contributions to expert evidence in List II.
List I: (Legal Cases)
P. Frye v. United States
Q. Daubert v. Merrell Dow
R. Kumho Tire v. Carmichael
S. General Electric v. Joiner
List II: (Core Legal Contributions)
1. Gatekeeper role applies to all expert testimony
2. Standard of appellate review is abuse of discretion
3. General acceptance by the scientific community
4. Judge as gatekeeper for scientific reliability factors
(A) P-3, Q-4, R-2, S-1
(B) P-4, Q-3, R-1, S-2
(C) P-3, Q-4, R-1, S-2
(D) P-4, Q-3, R-2, S-1

31. The phenomenon where the presence of the examiner or the act of observation inadvertently alters the phenomenon being studied, or where expectations subconsciously influence the interpretation of ambiguous data, is broadly termed:
(A) Systematic deviation
(B) Placebo effect
(C) Methodological shift
(D) Observer effect

32. Rule 702 of the Federal Rules of Evidence in the United States was significantly amended in 2000 primarily to codify the principles set forth by which landmark case?
(A) Frye v. United States
(B) Brady v. Maryland
(C) Daubert v. Merrell Dow Pharmaceuticals
(D) Miranda v. Arizona

33. Which document dictates the overarching policies, objectives, and organizational structure of a laboratory's quality management system?
(A) Standard Operating Procedure (SOP)
(B) Quality Manual
(C) Technical worksheet
(D) Maintenance logbook

34. Ethically, if a forensic scientist discovers that a laboratory procedure used in a previous case was flawed and might have led to a wrongful conviction, the scientist must:
(A) Maintain complete silence in order to protect the professional reputation of the laboratory
(B) Quietly fix the procedure for future cases without reporting the historical error to anyone
(C) Remain passive and wait until the defense attorney formally files an official appeal
(D) Disclose the error to laboratory authorities and legal stakeholders

35. The lowest concentration of an analyte in a sample that can be reliably distinguished from background noise but not necessarily quantified is the:
(A) Limit of Detection (LOD)
(B) Limit of Quantitation (LOQ)
(C) Measurement Uncertainty
(D) Calibration point

36. In India, the National Accreditation Board for Testing and Calibration Laboratories (NABL) operates as a constituent board of which overarching organization?
(A) Council of Scientific and Industrial Research (CSIR)
(B) Bureau of Indian Standards (BIS)
(C) Quality Council of India (QCI)
(D) Department of Science and Technology (DST)

37. To minimize cognitive bias, an evidence management protocol limits the information given to the analyst to only what is necessary for the examination, providing case context only after the scientific conclusions are drawn. This technique is known as:
(A) Sequential unmasking
(B) Forensic dry-labbing

Downloaded from www.pdf.tube

STUDYING FROM PDFs?

THINK AGAIN.

If you are studying only from PDFs,
you are wasting valuable time.

Research shows that learning from

PRINTED BOOKS has up to

4× HIGHER RETENTION

than studying from screens.

PRINT BOOK = BETTER MEMORY

PDF = LOWER RETENTION

Those who study from **PRINTED BOOKS**
move **AHEAD.**

Others are left **BEHIND**
in competition.

In competitive exams,
being average is not enough.

STAY ONE STEP AHEAD.

(C) Reagent spiking
(D) Target shifting effect

38. Consider the following statements regarding conflict of interest in forensic science:
I. A conflict of interest arises when personal, financial, or professional interests could influence an expert's objectivity.
II. Having a direct financial stake in the outcome of a trial is a clear conflict of interest.
III. Once a conflict of interest is identified, the expert can simply ignore it if they feel they are impartial.
Which combination of the above statements is correct?
(A) I and II only
(B) I and III only
(C) II and III only
(D) I, II, and III

39. During the extraction of DNA from a bloodstain, the analyst processes a sample containing a known DNA profile alongside the unknown evidence. This known sample functions as a:
(A) Procedural blank control
(B) Positive control
(C) Analytical reagent blank
(D) Negative extraction control

40. Arrange the following steps of the formal NABL accreditation process in the correct order:
I. Final assessment by the NABL audit team
II. Application submission by the laboratory
III. Granting of accreditation by NABL
IV. Document review and adequacy check by NABL
Which of the above options represents the correct sequence?
(A) II, I, IV, III
(B) II, IV, I, III
(C) IV, II, I, III
(D) II, IV, III, I

41. The legal ruling in General Electric Co. v. Joiner established that an appellate court should review a trial judge's decision to admit or exclude expert testimony under the standard of:
(A) De novo review
(B) Clear and convincing evidence
(C) Beyond a reasonable doubt
(D) Abuse of discretion

NODIA

42. The most critical ethical requirement regarding the language used in forensic reports and courtroom testimony is that the expert must:
(A) State the limitations and uncertainty of analytical findings
(B) Employ highly complex scientific jargon to demonstrate professional expertise to the court
(C) Present definitive and assertive conclusions even when test results are inconclusive
(D) Custom-tailor the scientific findings to align with the overall investigative theory

43. While ISO 9001 focuses broadly on quality management systems in any organization, ISO/IEC 17025 is specifically designed to assess:
(A) Environmental management systems and sustainability practices of manufacturing facilities
(B) Technical competence and validity of laboratory test results
(C) Comprehensive information security management systems within commercial enterprises
(D) Financial auditing, internal accounting standards, and fiscal compliance practices

44. Read the given statements regarding Quality Control in laboratory analysis and select the correct option.
Assertion (A): Running a blank sample alongside evidence samples is a Quality Control (QC) measure.
Reason (R): Quality Control ensures that the specific analytical run is free from contamination and that results are reliable.
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A)
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A)
(C) Assertion (A) is true, but Reason (R) is false
(D) Assertion (A) is false, but Reason (R) is true

45. If a laboratory balance consistently reads 0.5 mg heavier than the true mass of a certified weight, the balance is exhibiting:
(A) Systematic error
(B) Indeterminate random error
(C) Observational parallax error
(D) Representative sampling error

46. A set of unknown samples is sent by a central agency to ten different regional forensic laboratories. The results from each lab are then compared against the known true values to assess performance. This process is called:
(A) Routine internal quality system auditing
(B) Instrument calibration and standardization
(C) Inter-laboratory proficiency testing
(D) Intra-laboratory quality control assessment

47. Which of the following is NOT an accepted strategy to mitigate cognitive bias in forensic laboratories?
(A) Implementing strict linear sequential unmasking protocols during evidence evaluation
(B) Performing mandatory double-blind case verification procedures by independent analysts
(C) Restricting analyst access to extraneous and task-irrelevant case contextual information
(D) Permitting the investigating officer to observe testing directly

48. When a forensic analyst relies entirely on the output of an automated instrument without understanding the underlying scientific principles, and consequently misinterprets a false positive, it violates the ethical duty of:
(A) Preserving strict client and case confidentiality
(B) Maintaining an unbroken evidentiary chain of custody
(C) Professional competence and due care
(D) Ensuring prompt and timely case report submission

49. Under the Daubert standard, who is explicitly tasked with the "gatekeeping" responsibility to ensure that scientific testimony is both relevant and reliable?
(A) The jury
(B) The trial judge
(C) The prosecution attorney
(D) The lead forensic scientist

50. Match the types of bias in List I with their defining characteristics in List II.
List I: (Types of Bias)
P. Contextual bias
Q. Confirmation bias
R. Expectation bias
S. Adversarial allegiance
List II: (Defining Characteristics)
1. Bias toward the party retaining the expert
2. Seeking data that supports an initial hypothesis
3. Influence from task-irrelevant case information
4. Anticipating an outcome based on past routine
(A) P-3, Q-2, R-1, S-4
(B) P-2, Q-3, R-4, S-1
(C) P-4, Q-2, R-3, S-1
(D) P-3, Q-2, R-4, S-1

51. In forensic DNA analysis, a reagent blank is processed primarily to verify that:
(A) Extraction reagents are free from DNA contamination
(B) The thermal cycler equipment maintained accurate operating temperatures throughout
(C) The analyzing scientist holds all required academic degrees and professional certifications
(D) The extracted evidentiary DNA profile matches the reference profile of the primary suspect

52. A standard whose property values are assigned by a national metrology institute using primary methods and which has the highest metrological quality is called a:
(A) Calibrated secondary measurement standard
(B) Quantified internal analytical standard
(C) Primary reference standard
(D) Routine laboratory working standard

53. The capacity of an analytical procedure to remain unaffected by small, deliberate variations in method parameters (such as slight changes in pH or temperature) is defined as its:
(A) Robustness (or Ruggedness)
(B) Method limit of quantitation
(C) Analytical method specificity
(D) Instrument response linearity

54. An ethical violation occurs when a forensic expert deliberately omits scientific findings that point to the innocence of the accused. In legal terms, suppressing such favorable evidence is often associated with violating principles established in:
(A) Kumho Tire Co. v. Carmichael
(B) Frye v. United States
(C) Joiner v. General Electric
(D) Brady v. Maryland

Click Here to Buy book on Amazon

55. Consider the following statements regarding Quality Audits:
I. They are systematic and independent examinations of laboratory activities.
II. They aim to verify whether quality activities comply with planned arrangements.
III. They are used to punish analysts who make genuine random errors.
IV. They identify areas for continuous improvement in the quality system.
Which combination of the above statements is correct?
(A) I, II, and III only
(B) II, III, and IV only
(C) I, II, and IV only
(D) I, III, and IV only

56. One of the Daubert factors is "peer review and publication". The primary reason courts consider this factor is because:
(A) Unpublished scientific methods are strictly illegal to utilize in formal forensic casework
(B) Judicial officers can only comprehend scientific theories when published in legal journals
(C) Publication allows scrutiny by the scientific community for flaws
(D) It conclusively demonstrates that the expert witness holds a tenured university professorship

57. The property of a measurement result whereby the result can be related to a reference through a documented unbroken chain of calibrations is called:
(A) Inter-laboratory reproducibility
(B) Analytical limit of detection
(C) Standard measurement uncertainty
(D) Metrological traceability

58. A statistical tool frequently used in quality control to monitor whether an analytical process is in a state of statistical control over time is a:
(A) Control chart
(B) Categorical Venn diagram
(C) Proportional pie chart
(D) Chain of custody documentation form

59. Under Indian legal jurisprudence, an expert witness summoned to court is considered a witness of the:
(A) Prosecution, tasked with securing a conviction when summoned by state prosecutors
(B) Court, assisting the judge objectively on technical facts
(C) Defense counsel, tasked with advocating for the accused party during trial
(D) Investigating police agency responsible for collecting and submitting case evidence

60. Read the given statements regarding verification of forensic evidence and select the correct option.
Assertion (A): Blind verification of forensic evidence is highly recommended in subjective comparative sciences like fingerprinting.
Reason (R): Blind verification significantly reduces the risk of cognitive and confirmation bias by withholding the initial examiner's conclusion.
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A)
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A)
(C) Assertion (A) is true, but Reason (R) is false
(D) Assertion (A) is false, but Reason (R) is true

61. Parallax error, which occurs when an analyst reads a graduated cylinder from an improper angle, is generally classified as a/an:
(A) Personal systematic error
(B) Uncalibrated instrumental error
(C) Indeterminate experimental random error
(D) Inherent methodological procedure error

NODIA

62. The ISO/IEC 17025 standard is broadly divided into two main categories of requirements. These are:
(A) Personnel and Equipment requirements
(B) Internal and External requirements
(C) Management and Technical requirements
(D) Financial and Administrative requirements

63. Section 39 of the Bharatiya Sakshya Adhiniyam, 2023 deals primarily with:
(A) Confessions made to police officers
(B) Procedures for arrest
(C) Dying declarations
(D) Opinions of experts

64. In a quality assurance system, "Document Control" ensures that:
(A) All historical preliminary draft versions of a report are transmitted directly to the court
(B) Standard operational laboratory documents are published openly for public internet access

(C) Only current, approved versions of SOPs are used by staff
(D) Analysts maintain private handwritten bench notes without formal logging into official case files

65. Consider the following statements about internal audits in a forensic laboratory:
I. They must be conducted by external assessors from NABL.
II. They must be conducted periodically according to a predetermined schedule.
III. Auditors should preferably be independent of the activity being audited.
Which combination of the above statements is correct?
(A) I and II only
(B) I and III only
(C) II and III only
(D) I, II, and III

66. Under the Daubert ruling, a trial judge evaluating the reliability of a scientific technique should consider its "known or potential error rate". This factor emphasizes the importance of:
(A) The expert's communication skills
(B) The number of years the expert has been testifying
(C) Ensuring a zero-error outcome in every case
(D) Method validation and statistical evaluation

67. An expert witness is testifying in court, and the opposing counsel presents valid, peer-reviewed scientific evidence that contradicts a minor point in the expert's report. The ethical action for the expert is to:
(A) Acknowledge the valid evidence and clarify its effect on their conclusion
(B) Aggressively defend their original laboratory report regardless of the presented valid evidence
(C) Personally attack the professional credibility and competence of the opposing cross-examining counsel
(D) Completely refuse to answer the cross-examination question posed by the opposing legal team

68. Which sequence correctly represents the general steps of implementing a Corrective Action in a quality management system?
(A) Implement action → Identify nonconformity → Review effectiveness → Root cause analysis
(B) Identify nonconformity → Root cause analysis → Implement action → Review effectiveness
(C) Root cause analysis → Identify nonconformity → Review effectiveness → Implement action
(D) Review effectiveness → Implement action → Root cause analysis → Identify nonconformity

69. A forensic expert interprets ambiguous data to match the profile of the prime suspect and ignores data that does not fit. This is analogous to the logical fallacy where one shoots at a barn and then draws a target around the bullet holes, known as:
(A) The Texas Sharpshooter fallacy
(B) The Slippery Slope logical fallacy
(C) The Strawman argument logical fallacy
(D) The Ad Hominem attack logical fallacy

70. Match the method validation parameters in List I with their correct definitions in List II.
List I: (Method Validation Parameters)
P. Accuracy
Q. Precision
R. Specificity
S. Linearity
List II: (Definitions)
1. Closeness of agreement between independent test results
2. Ability to unequivocally assess the analyte in the presence of expected interferences
3. Closeness of agreement between a measured value and a true reference value
4. Ability to obtain test results directly proportional to the analyte concentration
(A) P-1, Q-3, R-2, S-4
(B) P-3, Q-1, R-4, S-2
(C) P-1, Q-3, R-4, S-2
(D) P-3, Q-1, R-2, S-4

71. International acceptance of a laboratory's test results is facilitated by NABL's signatory status to the Mutual Recognition Arrangement (MRA) of which global body?
(A) INTERPOL
(B) International Laboratory Accreditation Cooperation (ILAC)
(C) World Health Organization (WHO)
(D) United Nations Office on Drugs and Crime (UNODC)

72. The Daubert factor "whether the theory or technique can be and has been tested" is rooted

Downloaded from www.pdf.tube

in the philosophy of science concept known as "falsifiability", primarily proposed by:
(A) Isaac Newton
(B) Albert Einstein
(C) Karl Popper
(D) Thomas Kuhn

73. In forensic toxicology, an analyst deliberately adds a known amount of a drug to a drug-free blood sample and then extracts it to check the efficiency of the extraction process. This sample is called a/an:
(A) Procedural extraction reagent blank
(B) Instrument external calibration standard
(C) Zero-concentration calibration blank
(D) Spiked sample

74. An ethical breach where an expert witness uses phrases like "100% certain" or "to the exclusion of all others in the world" in disciplines where such statistical certainty is impossible (e.g., hair morphology or toolmarks) is known as:
(A) Overstating the evidence
(B) Intentional falsification of data
(C) Forensic dry-labbing of results
(D) Academic and scientific plagiarism

75. To maintain reagent quality control, a forensic laboratory must ensure that:
(A) Laboratory reagents are indefinitely retained and never discarded in order to minimize operational costs
(B) Reagents are labeled with identity, concentration, and expiry date
(C) Chemical reagents are maintained and stored exclusively at ambient room temperature conditions
(D) Prepared reagents are routinely transferred into unlabeled secondary containers for daily bench testing

76. Consider the following statements regarding the chain of custody:
I. It requires documenting the chronological history of a piece of evidence.
II. A broken chain of custody may render the evidence inadmissible in court.
III. Electronic tracking systems cannot be used for chain of custody logs.
IV. It begins only when the evidence arrives at the forensic laboratory.
Which combination of the above statements is correct?
(A) I and II only
(B) I, II, and IV only
(C) II and III only
(D) I, III, and IV only

NODIA

77. A forensic scientist hired by the defense subconsciously interprets borderline results in a way that favors the defense theory. This specific type of bias is known as:
(A) Adversarial allegiance
(B) Subconscious observer effect
(C) Statistical base-rate fallacy
(D) Unconscious reference bias

78. In the context of precision during method validation, the precision obtained when measurements are made under the same operating conditions over a short time interval (same analyst, same equipment) is called:
(A) Reproducibility
(B) Linearity
(C) Repeatability
(D) Robustness

79. Arrange the following steps of forensic case management and examination in the standard sequential order:
I. Issue of the final forensic report
II. Technical and administrative review of the findings
III. Receipt of evidence and verification of seals
IV. Execution of Standard Operating Procedures for analysis
Which of the above options represents the correct sequence?
(A) III, IV, II, I
(B) III, II, IV, I
(C) IV, III, II, I
(D) II, III, IV, I

80. While Indian courts are not strictly bound by the Daubert standard, they often implicitly apply its principles under Section 45 of the Indian Evidence Act to determine:
(A) The total financial cost incurred during the scientific analysis of the physical evidence
(B) Determining whether the fee for expert testimony should be compensated directly by the state
(C) Scientific validity and reliability of the expert's methodology
(D) The internal administrative hierarchy and organizational structure of the forensic facility

81. In reporting measurement uncertainty (e.g., Blood Alcohol Concentration is 0.08 ± 0.005 g/100mL), the ± value typically represents an interval containing the true value with a specific probability. This interval is called the:
(A) Limit of quantitation
(B) Confidence interval
(C) Systematic deviation
(D) Correlation coefficient

82. Consider the following statements regarding proficiency testing in forensic science:
I. It evaluates the competency of the individual analyst and the laboratory.
II. Blind proficiency tests are completely known to the analyst to ensure no mistakes are made.
III. Failure in a proficiency test usually triggers a corrective action process.
Which combination of the above statements is correct?
(A) I and II only
(B) I and III only
(C) II and III only
(D) I, II, and III

83. If a senior police officer pressures a subordinate forensic expert at a state forensic laboratory to alter a scientific conclusion to secure a conviction, the ethical duty of the expert is to:
(A) Refuse and report the interference to laboratory management
(B) Fully comply with the directives, as the investigating officer holds higher administrative authority
(C) Secretly alter the scientific conclusion while leaving a hidden explanatory note inside the physical file
(D) Quietly submit a formal resignation immediately without reporting the improper pressure to anyone

84. In a DNA profiling laboratory, maintaining positive air pressure in the pre-amplification room relative to the post-amplification room is a QA/QC measure designed to:
(A) Maintain comfortable ambient temperature conditions for working analytical laboratory staff
(B) Significantly reduce the total electrical power consumption of operational PCR equipment
(C) Prevent amplified DNA from contaminating evidence samples
(D) Ensure that stored chemical reagents do not prematurely undergo thermal degradation

85. Match the quality management terms in List I with their primary functions in List II.
List I: (Terms)
P. SOP
Q. Calibration
R. CRM
S. Internal Audit
List II: (Primary Functions)
1. Used to ensure an instrument reading is accurate
2. Used as a known standard with a certified property value
3. Used to assess the laboratory's compliance with its own quality system
4. Used to provide a step-by-step instructional guide for a procedure
(A) P-4, Q-1, R-2, S-3
(B) P-4, Q-2, R-1, S-3
(C) P-1, Q-4, R-2, S-3
(D) P-3, Q-1, R-2, S-4

86. When an analyst subconsciously expects a specific result based on past experience (e.g., expecting a particular presumptive color test to turn purple because it has done so in the last fifty drug cases), and prematurely calls the result without waiting the required time, it is an example of:
(A) Dry-labbing
(B) Equipment failure
(C) Intentional misconduct
(D) Expectation bias

87. The Frye standard, which required "general acceptance" of a scientific technique, was the dominant standard in the US for decades. In which year was the Frye decision handed down?
(A) 1975
(B) 1923
(C) 1993
(D) 2000

88. Read the given statements regarding legal standards for expert testimony and select the correct option.
Assertion (A): The Daubert standard superseded the Frye standard in the US federal court system.
Reason (R): The US Supreme Court ruled that the enactment of the Federal Rules of Evidence in 1975 effectively overruled the rigid "general acceptance" requirement of Frye.
(A) Both Assertion (A) and Reason (R) are true

Click Here to Buy book on Flipkart

and Reason (R) is the correct explanation of Assertion (A)
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A)
(C) Assertion (A) is true, but Reason (R) is false
(D) Assertion (A) is false, but Reason (R) is true

89. According to ISO/IEC 17025, records of equipment maintenance and calibration must be:
(A) Routinely discarded at the end of each fiscal year to minimize physical laboratory storage space
(B) Maintained exclusively and privately by the field service technicians of the manufacturer
(C) Formally published and made continuously accessible to the general public on an open website
(D) Updated regularly and securely retained for a defined period

90. Ultimately, the highest ethical and legal duty of a forensic science assistant presenting evidence before a court is owed to:
(A) The Court and justice administration
(B) The administrative Directorate of Forensic Science
(C) The primary Investigating Police Officer in charge
(D) The defense attorney representing the accused party

www.nodia.in

Downloaded from www.pdf.tube

ANSWERS

1. (B) The scientific evidence and the truth
Expert witnesses in forensic science bear an overriding duty to maintain complete objectivity, impartiality, and scientific integrity when providing courtroom testimony. Rather than acting as an advocate for either party in litigation, their primary role is to serve justice by presenting scientific findings accurately, transparently, and truthfully based strictly on sound scientific principles.

2. (D) QA is process-oriented and proactive, while QC is product-oriented and reactive
Quality assurance encompasses planned, systemic organizational policies and operational management measures designed to prevent errors before testing occurs. In contrast, quality control involves specific technical operational activities and measurements used to detect errors, verify analytical output, and evaluate whether technical execution meets established quality standards during routine testing procedures within analytical operational facilities.

3. (A) ISO/IEC 17025
ISO/IEC 17025 is the globally recognized international standard that specifies requirements for the technical competence, impartiality, and consistent operational management of testing and calibration laboratories. Forensic facilities adopt this standard to demonstrate operational reliability, generate valid technical data, and maintain high standards of quality assurance during forensic analytical casework evaluation procedures.

4. (C) Frye v. United States
The landmark ruling established that scientific testimony and expert evidence are admissible in court only if the underlying scientific principle or technique has gained general acceptance within the relevant scientific community. This historical legal decision created the foundational framework governing expert scientific testimony admissibility for many decades prior to modern judicial updates.

NODIA

5. (A) Confirmation bias
Confirmation bias is a psychological cognitive bias where an examiner actively seeks, interprets, or prioritizes evidence that confirms a pre-existing belief or hypothesis while simultaneously ignoring or discounting contradictory observations. In forensic examinations, this cognitive distortion compromises objective analytical evaluations and increases the risk of reaching erroneous conclusions during comparative analysis procedures.

6. (D) Method validation
Method validation is the formal process of experimentally proving that a specific analytical protocol is reliable, accurate, precise, and suitable for its intended purpose. Through rigorous testing of parameters such as selectivity, calibration range, and robustness, laboratories establish objective documented proof that an analytical procedure yields consistent and trustworthy results during casework testing.

7. (B) The academic pedigree and university affiliation of the expert witness
Under the judicial gatekeeping framework, judges evaluate scientific reliability using factors including empirical testing, peer review, publication, known error rates, and general scientific acceptance. Personal institutional affiliations or academic titles are not formal factors for determining method reliability, ensuring that scientific validity is judged strictly on objective scientific merits rather than personal credentials.

8. (C) National Accreditation Board for Testing and Calibration Laboratories
The National Accreditation Board for Testing and Calibration Laboratories provides formal third-party recognition of technical competence for analytical and testing laboratories in India. Operating under international operational guidelines, it assesses testing facilities to ensure compliance with global quality management standards, metrological traceability requirements, and sound scientific practices across diverse laboratory disciplines.

9. (D) Foreign law, science, art, handwriting, or finger impressions
Statutory evidentiary provisions explicitly permit judicial courts to seek specialized expert opinion when forming judgments on technical subjects beyond common knowledge. These legal fields specifically include questions concerning foreign law, scientific principles, artistic evaluation, handwriting identification, and friction ridge fingerprint analysis, where technical expertise provides essential guidance to aid administrative judicial decision-making.

10. (A) Systematic errors
Systematic errors are repeatable, predictable deviations in experimental measurement that consistently shift analytical values in the same direction relative to true values. Often caused by flawed instrument calibration, degraded reagents, or faulty equipment setup, systematic errors alter measurement accuracy but can be identified, quantified, and corrected through proper calibration and procedural quality management controls.

11. (B) Disclose the conflict of interest and recuse themselves from the case
Forensic professionals must uphold absolute objectivity and avoid any actual or perceived personal bias in scientific analysis. When a personal relationship creates a direct conflict of interest, ethical codes require immediate full disclosure to authorities and complete recusal from the investigation to preserve scientific integrity, evidentiary credibility, and public trust in judicial outcomes.

12. (B) I and III only
Under ISO/IEC 17025 standards, accredited testing laboratories must establish rigorous metrological traceability to national standards and systematically evaluate measurement uncertainty for quantitative procedures. The standard does not restrict laboratories to non-standard methods; rather, standard validated methods are encouraged, provided method performance parameters are thoroughly verified prior to implementation in routine casework testing.

13. (A) Internal audit
An internal audit is a systematic, independent assessment carried out periodically by qualified laboratory staff to verify whether operational activities conform to planned arrangements and quality system standards. This internal evaluation mechanism helps identify procedural nonconformities, ensures adherence to operational protocols, and supports continuous quality improvement across all administrative and technical laboratory operations.

14. (C) Proficiency testing
Proficiency testing involves evaluating laboratory performance by distributing standardized unknown samples to multiple testing facilities for independent analysis. Comparing analytical results against predetermined technical criteria allows assessment of analyst competency, verification of method reliability, identification of systematic analytical deviations, and fulfillment of essential quality assurance mandates necessary for institutional laboratory accreditation maintenance.

15. (D) Contextual bias
Contextual bias occurs when extraneous, task-irrelevant information—such as police reports or suspect confessions—subconsciously influences an examiner's interpretation of physical evidence. Exposure to external case details impairs objective evaluation, particularly in subjective comparative analyses, emphasizing the necessity of masking extraneous context to maintain scientific objectivity and minimize observer bias in casework evaluation.

16. (C) Certified Reference Materials (CRMs)
Certified Reference Materials provide established reference values accompanied by metrological uncertainty and documented traceability to recognized international standards. Analytical laboratories utilize these certified materials to calibrate sensitive instruments, validate experimental methods, and confirm measurement accuracy, ensuring that experimental results remain precise, traceable, and legally defensible when presented in formal legal proceedings.

17. (B) Kumho Tire Co. v. Carmichael
The Supreme Court decision expanded the judicial gatekeeping mandate established under Daubert, clarifying that trial judges must assess the reliability and relevance of all expert witness testimony. This obligation applies not only to scientific evidence but equally to technical, engineering, and other specialized non-scientific

Click Here to Buy book on Amazon

expert testimony presented during formal judicial trial proceedings.

18. (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A)
Documenting an unbroken chain of custody is a foundational quality assurance measure that records every custodian handling evidence from collection to trial. Detailed records verify evidence integrity, proving that physical items were protected from contamination, substitution, or unauthorized alteration, thereby providing the legal foundation necessary for admitting physical evidence into judicial court proceedings.

19. (A) Blank sample
A blank sample contains all operational solvents and reagents used in analysis without the target analyte. Subjecting a blank sample to identical processing controls verifies that laboratory chemicals, containers, and analytical instruments are free from external contamination, ensuring that observed analytical signals originate solely from the evidentiary specimen rather than laboratory environment interferences.

20. (C) Ensure consistency, reliability, and reproducibility in procedures
Standard Operating Procedures provide step-by-step instructions detailing approved analytical techniques and administrative rules for laboratory personnel. By standardizing experimental workflows, SOPs minimize operational variance between analysts, maintain high precision and accuracy, satisfy quality system standards, and ensure that scientific results generated within testing facilities remain reproducible, robust, and legally defensible during judicial proceedings.

21. (A) Dry-labbing
Dry-labbing represents an egregious ethical violation in which an analyst fabricates experimental data and issues formal scientific results without ever conducting the actual laboratory testing. This fraudulent misconduct completely undermines the scientific process, compromises justice administration, violates core ethical mandates, and can lead to serious wrongful judicial convictions in legal proceedings.

22. (A) Daubert v. Merrell Dow → General Electric Co. v. Joiner → Kumho Tire Co. v. Carmichael
The legal framework governing scientific expert evidence in United States courts developed chronologically through three key Supreme Court decisions: Daubert v. Merrell Dow (1993) established gatekeeping factors; General Electric Co. v. Joiner (1997) defined the abuse of discretion appellate standard; and Kumho Tire Co. v. Carmichael (1999) extended gatekeeping to all specialized non-scientific testimony.

23. (B) Specifically authorized by law or by the client/court
Forensic scientists are bound by professional duties of confidentiality regarding casework details and analytical findings. Confidential information may only be disclosed when explicitly permitted by statutory law, court directives, or formal authorization from the submitting authority. Informal discussions or media disclosures without proper legal authorization violate professional ethics and breach confidentiality obligations.

NODIA

24. (C) Double-blind verification
Double-blind verification is an advanced quality control procedure where an independent secondary examiner evaluates evidence without prior knowledge of the primary examiner's findings or the case context. By masking both the identity of the original conclusions and case particulars, double-blind verification eliminates confirmation bias, supporting independent, objective scientific evaluations within accredited testing facilities.

25. (B) I and III only
The Frye standard, established in 1923 following a case involving a crude systolic blood pressure deception test, required general scientific acceptance for expert evidence admissibility. It did not designate the judge as a flexible gatekeeper—a role established later under Daubert—and it is no longer the governing admissibility standard across federal courts.

26. (A) Measurement uncertainty
Measurement uncertainty is a non-negative parameter that quantifies the dispersion of values reasonable to attribute to a measured physical quantity. Incorporating sources of variability such as ambient conditions, operator variation, and calibration tolerances, it provides essential quantitative context regarding the precision and

statistical reliability of numerical laboratory analytical results generated during casework.

27. (B) Taking replicate measurements and calculating the mean
Random errors represent non-repeatable, unpredictable statistical fluctuations that affect measurement precision equally in positive and negative directions. Taking multiple replicate measurements of a sample and calculating the mathematical mean effectively averages out individual random variations, thereby reducing measurement variance and enhancing the statistical precision of quantitative analytical determinations within testing facilities.

28. (B) Preventive action
Preventive action is a proactive quality management process designed to identify potential sources of nonconformity or system weakness before errors occur. Unlike corrective action, which responds after a deviation has taken place, preventive action analyzes operational trends, risk assessments, and processes to eliminate potential root causes and ensure continuous operational compliance.

29. (A) Calibration
Calibration is the operation that establishes a relationship between the quantity values provided by reference standards and the corresponding indications of a measuring instrument. By adjusting and documenting instrument performance against traceable references of known accuracy, calibration ensures measurement precision, reduces systematic operational bias, and maintains metrological traceability across laboratory analyses.

30. (C) P-3, Q-4, R-1, S-2
Legal precedents established clear evidentiary standards: Frye v. United States introduced the general acceptance test; Daubert v. Merrell Dow designated trial judges as gatekeepers using multi-factor reliability criteria; Kumho Tire extended this gatekeeping function to non-scientific technical evidence; and General Electric Co. v. Joiner established abuse of discretion as appellate review standard.

31. (D) Observer effect
The observer effect describes psychological phenomena wherein the presence, expectations, or preconceptions of an examiner subconsciously alter analytical observations or influence the interpretation of ambiguous data. In forensic testing, managing observer effects requires implementing blind evaluation protocols and objective analytical safeguards to eliminate psychological bias and ensure impartial evidence interpretation during casework.

32. (C) Daubert v. Merrell Dow Pharmaceuticals
Rule 702 of the Federal Rules of Evidence was amended in 2000 to codify judicial principles established in Daubert v. Merrell Dow Pharmaceuticals. The rule explicitly mandates that expert testimony must be based upon sufficient facts, rely on reliable principles and methods, and result from reliable application of those methods to facts.

33. (B) Quality Manual
A Quality Manual is the core document establishing an organization's overall quality management policies, operational objectives, organizational hierarchy, and general administrative commitments. Serving as the primary framework of the quality infrastructure, it directs standard operational procedures, technical documentation, and quality assurance mechanisms necessary to achieve consistent operational standards and lab accreditation.

34. (D) Disclose the error to laboratory authorities and legal stakeholders
Forensic ethics strictly mandate that scientists immediately report newly discovered procedural flaws or systemic analytical errors that could impact historical casework. Disclosing such technical errors to laboratory management and legal authorities ensures transparent corrective action, protects constitutional rights, upholds judicial integrity, and helps remedy potential past wrongful convictions resulting from flawed evidence.

35. (A) Limit of Detection (LOD)
The Limit of Detection represents the lowest analyte concentration in a sample that can be reliably distinguished from baseline analytical noise with reasonable statistical certainty. While confirming presence, the LOD does not require precise quantitative measurement, which is instead defined by the higher threshold known as the Limit of Quantitation in analytical chemistry.

Downloaded from www.pdf.tube

36. (C) Quality Council of India (QCI)
The National Accreditation Board for Testing and Calibration Laboratories functions as an autonomous constituent board operating under the administrative oversight of the Quality Council of India. QCI establishes national quality infrastructure and oversees bodies providing accreditation to testing, calibration, and medical laboratories in alignment with global quality evaluation accreditation guidelines.

37. (A) Sequential unmasking
Linear sequential unmasking is a bias-mitigation technique that controls the timing and flow of case information provided to forensic analysts. By ensuring examiners analyze physical evidentiary features prior to reviewing reference standards or extraneous contextual details, sequential unmasking prevents cognitive confirmation bias from influencing technical scientific interpretations during comparative examinations.

38. (A) I and II only
Conflicts of interest occur when financial, professional, or personal connections threaten an expert's scientific objectivity. Having direct financial or personal ties to trial outcomes creates an unambiguous operational conflict. Once identified, ethical guidelines dictate that experts cannot simply ignore conflicts but must formally disclose them and recuse themselves from casework participation.

39. (B) Positive control
A positive control contains a known target substance analyzed alongside evidence samples under identical test conditions. In DNA processing, analyzing a control with a known profile confirms that reagents, thermal cyclers, and analytical steps operated correctly, verifying that the testing system effectively detects target material without procedural failure or system degradation.

40. (B) II, IV, I, III
Formal accreditation by NABL follows a structured sequential workflow: the testing laboratory first submits an official application, followed by document review and adequacy assessment of quality manuals. Upon successful documentation check, NABL conducts an on-site final assessment audit, ultimately granting formal accreditation upon resolving any identified operational nonconformities.

41. (D) Abuse of discretion
In General Electric Co. v. Joiner, the United States Supreme Court ruled that appellate courts must apply an abuse of discretion standard when reviewing a trial judge's decision to admit or exclude expert scientific testimony. This standard grants significant deference to judicial gatekeepers when evaluating scientific evidentiary reliability during court proceedings.

42. (A) State the limitations and uncertainty of analytical findings
Forensic scientists are ethically bound to communicate test results clearly, accurately, and objectively. Expert reports and oral courtroom testimony must explicitly detail analytical limitations, measurement uncertainty, and methodological constraints, avoiding overstated conclusions or misleading technical jargon to ensure the finder of fact fully comprehends the true scientific weight of physical evidence.

43. (B) Technical competence and validity of laboratory test results
While ISO 9001 provides broad requirements for general business quality management, ISO/IEC 17025 specifically evaluates testing and calibration laboratories. It assesses both management controls and technical competence, ensuring that testing facilities utilize validated methods, calibrated instrumentation, skilled personnel, and rigorous quality assurance to produce valid, reliable analytical data during casework.

NODIA

44. (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A)
Running blank samples concurrently with evidentiary specimens is a vital quality control protocol. Processing reagent blanks ensures the analytical batch is free from external chemical or biological contamination, validating that measured instrument signals originate exclusively from the sample and establishing the analytical reliability of the operational testing run within analytical laboratories.

45. (A) Systematic error
A consistent deviation where a measuring instrument repeatedly outputs readings higher

or lower than true values by a fixed magnitude represents a systematic error. Unlike random fluctuations, systematic errors affect analytical measurement accuracy in a predictable manner and can be rectified through instrument re-calibration, component replacement, or standard mathematical baseline corrections.

46. (C) Inter-laboratory proficiency testing
Inter-laboratory proficiency testing involves distributing identical standardized unknown samples to multiple independent forensic facilities to assess analytical consistency across laboratories. Evaluating test outcomes against reference standards enables quality bodies to monitor laboratory technical performance, identify inter-laboratory bias, verify method reproducibility, and fulfill essential accreditation oversight requirements within modern forensic science.

47. (D) Permitting the investigating officer to observe testing directly
Allowing investigating officers to directly observe testing introduces extraneous context, investigative expectations, and potential pressure, thereby increasing the risk of cognitive bias. Accepted strategies to minimize cognitive distortions include linear sequential unmasking, double-blind verification, and strict restriction of non-essential, task-irrelevant case information during technical evidence evaluation within accredited testing facilities.

48. (C) Professional competence and due care
Blindly relying on automated analytical instruments without understanding underlying physical or chemical operational principles violates fundamental duties of professional competence and due care. Forensic analysts must possess appropriate scientific knowledge to evaluate instrument outputs, recognize potential false positives or matrix interferences, and ensure that published findings remain technically accurate and scientifically valid.

49. (B) The trial judge
Under the Daubert framework, trial judges are explicitly assigned the role of evidentiary gatekeeper. In this capacity, judges must make a preliminary assessment of whether proposed expert witness testimony is based on scientifically valid, reliable methodologies and whether those methods are relevant and properly applicable to the specific legal issues presented at trial.

50. (D) P-3, Q-2, R-4, S-1
Cognitive biases in forensic analysis manifest distinctly: contextual bias stems from task-irrelevant case information; confirmation bias involves selectively seeking data supporting a pre-existing hypothesis; expectation bias occurs when anticipating outcomes based on routine experience; and adversarial allegiance describes a conscious or subconscious bias toward the retaining legal party in court.

51. (A) Extraction reagents are free from DNA contamination
In forensic DNA profiling, a reagent blank contains all extraction chemicals and solvents but lacks biological sample input. Processing a reagent blank through extraction and amplification controls verifies that testing materials and procedures are completely free from extraneous DNA contamination, guaranteeing that detected genetic profiles originate solely from evidentiary casework samples.

52. (C) Primary reference standard
A primary reference standard possesses the highest metrological quality, whose value is established without comparison to other standards of the same quantity. Typically designated by national metrology institutes using primary reference methods, it serves as the ultimate benchmark to calibrate secondary standards, establish traceability, and maintain global analytical measurement accuracy.

53. (A) Robustness (or Ruggedness)
Method robustness, often evaluated alongside ruggedness, measures the capacity of an analytical procedure to remain unaffected by small, deliberate operational variations. Demonstrating that minor fluctuations in experimental parameters—such as slight changes in solvent pH, reagent concentration, or column temperature—do not compromise analytical performance confirms the reliability and stability of the method.

54. (D) Brady v. Maryland
In Brady v. Maryland, the United States Supreme Court established that constitutional due process requires the prosecution to disclose exculpatory evidence to the defense. Ethically and legally,

Click Here to Buy book on Flipkart

suppressing or omitting scientific findings that point to the innocence of the accused violates constitutional disclosure requirements and fundamental legal principles of justice.

55. (C) I, II, and IV only
Quality audits are systematic, independent examinations that evaluate whether laboratory activities conform to documented management systems and operational standards. Their primary purpose is to identify opportunities for continuous quality improvement and ensure procedural compliance, rather than serving as punitive tools against analysts for genuine, unavoidable random experimental measurement errors within facilities.

56. (C) Publication allows scrutiny by the scientific community for flaws
Subjecting a scientific technique to peer review and publication provides critical scrutiny by the broader scientific community. This independent evaluation process helps expose methodological flaws, assesses experimental reliability, establishes error rates, and ensures that techniques used in legal proceedings are backed by robust scientific principles rather than unverified analytical assertions.

57. (D) Metrological traceability
Metrological traceability is the property of a measurement result whereby it can be related to a recognized international standard through an unbroken, documented chain of calibrated measurement steps. Each step must include stated measurement uncertainties, ensuring that quantitative values are comparable, standard-aligned, scientifically valid, and defensible in formal court proceedings.

58. (A) Control chart
A control chart is a fundamental statistical tool utilized in quality control to monitor process consistency over time. By plotting sequential measurement data alongside upper and lower control limits derived from historical performance, control charts help analysts visually identify systematic shifts, random trends, or out-of-control conditions requiring technical corrective action within laboratories.

59. (B) Court, assisting the judge objectively on technical facts
Under Indian jurisprudence, an expert witness functions as an independent officer assisting the court on specialized technical issues. Regardless of which legal party summons the expert or pays testimony fees, their legal and ethical obligation is owed exclusively to the judicial tribunal, requiring objective, unbiased, and scientifically sound evidence presentation during trial proceedings.

60. (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A)
Blind verification is strongly recommended in subjective pattern-matching disciplines like fingerprint evaluation. Withholding the primary analyst's conclusions and contextual details prevents cognitive bias, confirmation bias, and peer influence from affecting the secondary examiner, thereby ensuring an independent scientific verification and significantly enhancing result reliability in forensic casework assessments.

61. (A) Personal systematic error
Parallax error occurs when an analyst reads liquid volume or scale graduations from an incorrect angle rather than at eye level. Classified as a personal systematic error, it introduces a consistent observational bias that predictably skews physical measurements in one direction until proper observation techniques and standardized operational practices are implemented.

NODIA

62. (C) Management and Technical requirements
The ISO/IEC 17025 standard is structured around two main operational pillars: management requirements and technical requirements. Management requirements focus on organizational quality systems, document control, and audits, while technical requirements address personnel competence, environmental conditions, test method validation, equipment calibration, and measurement uncertainty evaluations within accredited testing laboratory facilities.

63. (D) Opinions of experts
Section 39 of the Bharatiya Sakshya Adhiniyam, 2023 governs the relevancy of expert opinions in court proceedings. Mirroring Section 45 of the former Indian Evidence Act, 1872, this statutory

provision establishes legal framework conditions under which scientific, technical, artistic, handwriting, and fingerprint expert opinions are admissible as relevant facts in trials.

64. (C) Only current, approved versions of SOPs are used by staff
Document control is an essential quality assurance mandate requiring systematic management of all operational documentation. By controlling creation, approval, distribution, and archiving of SOPs and technical protocols, document control guarantees that laboratory personnel exclusively utilize current, authorized procedures, preventing obsolete or unverified protocols from compromising analysis quality during casework.

65. (C) II and III only
Internal audits must be conducted periodically according to a predetermined schedule by trained internal staff rather than external accrediting assessors. To preserve objectivity and independence, internal auditors should preferably be independent of the specific technical or operational activities being audited, ensuring unbiased evaluation of quality system compliance across laboratory operations.

66. (D) Method validation and statistical evaluation
Assessing the known or potential error rate under the Daubert gatekeeping standard emphasizes the necessity of empirical method validation and quantitative statistical evaluation. Scientific techniques must undergo rigorous experimental testing to calculate false positive and false negative rates, ensuring judges evaluate scientific reliability based on objective performance metrics during trial proceedings.

67. (A) Acknowledge the valid evidence and clarify its effect on their conclusion
Ethical codes require forensic experts to remain objective, honest, and scientifically flexible during courtroom testimony. When presented with valid, peer-reviewed scientific data during cross-examination, an expert must candidly acknowledge the conflicting evidence and explain how it affects, qualifies, or refines their professional scientific findings without becoming defensive or argumentative in court.

68. (B) Identify nonconformity → Root cause analysis → Implement action → Review effectiveness
Implementing corrective action follows a logical sequence in quality management: first, the laboratory identifies an operational nonconformity; next, a thorough root cause analysis pinpoints the underlying failure; then, appropriate corrective measures are implemented; and finally, management reviews effectiveness to ensure the nonconformity is permanently eliminated across all operational laboratory workflows.

69. (A) The Texas Sharpshooter fallacy
The Texas Sharpshooter fallacy describes a logical error where patterns are falsely identified by selectively highlighting similarities while ignoring key differences in data. In forensic analysis, interpreting ambiguous data solely to match a specific suspect profile mirrors drawing a target around random bullet holes, resulting in biased and scientifically flawed conclusions.

NODIA

70. (D) P-3, Q-1, R-2, S-4
Method validation parameters reflect distinct analytical performance characteristics: accuracy measures closeness of measured values to reference true values; precision assesses agreement between independent replicate results; specificity evaluates target analyte measurement in the presence of interferences; and linearity defines the ability to yield results directly proportional to concentration across test ranges.

71. (B) International Laboratory Accreditation Cooperation (ILAC)
Global acceptance of testing and calibration data is supported by NABL's status as a signatory to the Mutual Recognition Arrangement of the International Laboratory Accreditation Cooperation. Through ILAC MRA arrangements, test reports issued by accredited Indian facilities are recognized internationally, facilitating cross-border legal acceptance and technical equivalence of laboratory testing results.

72. (C) Karl Popper
The requirement that a scientific theory or technique must be capable of being tested is grounded in Karl Popper's philosophy of science, specifically his concept of empirical falsifiability. Popper posited that for a claim to be genuinely scientific, it must make testable predictions that

can potentially be proven false through empirical investigation.

73. (D) Spiked sample
A spiked sample is created by adding a known concentration of a target analyte to a matrix sample free from that substance. In toxicological testing, processing spiked matrix controls alongside unknowns allows analysts to determine extraction efficiency, calculate method recovery percentages, evaluate matrix effects, and ensure analytical protocol accuracy during casework evaluations.

74. (A) Overstating the evidence
Asserting absolute scientific certainty or claiming match conclusions to the exclusion of all other potential sources in comparative disciplines constitutes overstating evidence. Ethical guidelines prohibit presenting individualization claims that exceed empirical method limits, requiring experts to accurately communicate probabilistic limitations and scientific uncertainty to avoid misleading judicial finders of fact in court.

75. (B) Reagents are labeled with identity, concentration, and expiry date
Proper reagent quality control mandates clear labeling of chemical reagents with identity, concentration, preparation date, storage conditions, and expiration date. Systematically tracking reagent integrity prevents chemical degradation or contamination from compromising analytical runs, ensuring that laboratory testing yields reliable, accurate, and legally defensible scientific data across all casework analytical testing procedures.

76. (A) I and II only
Maintaining evidence integrity requires documenting complete chronological handling from initial scene recovery to final court presentation. Gaps or breaks in chain of custody logs threaten physical integrity and can lead courts to deem evidence inadmissible. Modern tracking routinely utilizes secure electronic logs, beginning immediately upon evidence collection at crime scene locations.

77. (A) Adversarial allegiance
Adversarial allegiance describes a psychological bias where expert witnesses subconsciously align their technical evaluations with the goals of the legal party retaining them. When hired by either prosecution or defense, experts may involuntarily interpret ambiguous analytical data in ways favorable to their retaining team, compromising the scientific objectivity required in judicial proceedings.

78. (C) Repeatability
Repeatability assesses measurement precision under strictly identical operating conditions over a short time interval. In method validation, repeatability evaluates variability when measurements are conducted by the same analyst using identical equipment, reagents, and instruments within the same laboratory, establishing baseline precision limits before evaluating broader inter-analyst or inter-laboratory reproducibility performance parameters.

79. (A) III, IV, II, I
Efficient forensic case management follows a strict operational sequence: the laboratory receives physical evidence and verifies seal integrity; qualified analysts execute Standard Operating Procedures for testing; technical and administrative reviews independently audit test data and draft findings; and finally, the facility formally issues the final verified forensic analytical report to submitting authorities.

80. (C) Scientific validity and reliability of the expert's methodology
While Daubert is a US legal precedent, Indian courts frequently apply similar foundational principles when interpreting expert relevance under Section 45 of the Indian Evidence Act. Judicial bodies evaluate whether scientific methodologies underlying expert opinions are tested, reliable, peer-reviewed, and scientifically valid before relying on expert technical findings to adjudicate legal matters.

81. (B) Confidence interval
A confidence interval defines an estimated statistical range that is expected to encompass the true measurand value with a specified probability level, typically ninety-five percent. In quantitative reporting, stating measurement uncertainty alongside mean values establishes boundaries within which true analytical results lie, providing essential scientific clarity regarding quantitative precision during court presentation.

Downloaded from www.pdf.tube

82. (B) I and III only
Proficiency testing systematically assesses analyst competency and overall laboratory testing capability. In blind proficiency testing, samples are disguised as routine casework, meaning analysts are unaware they are being evaluated. Identifying failures during proficiency testing triggers formal corrective action investigations to locate root causes and rectify operational technical defects.

83. (A) Refuse and report the interference to laboratory management
Forensic scientists possess an absolute ethical duty to preserve scientific independence and resist external administrative pressure to modify findings. When improper pressure is exerted by law enforcement or external authorities, experts must firmly refuse to compromise analytical conclusions and immediately report the undue interference to laboratory management and appropriate administrative authorities.

84. (C) Prevent amplified DNA from contaminating evidence samples
Maintaining positive air pressure in pre-amplification cleanrooms relative to post-amplification areas prevents airborne aerosolized PCR amplicons from migrating into pre-amplification spaces. This engineering quality control safeguard isolates unamplified evidentiary DNA samples from millions of copied target DNA fragments, preventing cross-contamination that could cause catastrophic false positive profiling results during casework.

85. (A) P-4, Q-1, R-2, S-3
Core quality management elements serve dedicated roles: Standard Operating Procedures provide step-by-step instructions for analytical tasks; calibration establishes instrument measurement accuracy; Certified Reference Materials provide known standard values with metrological traceability; and internal audits assess organizational compliance against internal quality management guidelines and accreditation requirements across facilities.

86. (D) Expectation bias
Expectation bias occurs when an analyst anticipates a specific outcome based on past routine experience or prior case outcomes. Expecting a reaction to behave predictably leads to premature conclusions without completing full observation periods or verifying controls, creating a cognitive distortion that undermines scientific rigor and objective evidence interpretation during casework.

87. (B) 1923
The landmark judicial ruling in Frye v. United States was handed down in 1923 by the District of Columbia Court of Appeals. The decision established the "general acceptance" rule for scientific evidence, which governed the admissibility of expert scientific testimony in United States courts for seven decades before the Daubert standard.

88. (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A)
The United States Supreme Court held in Daubert that enacting the Federal Rules of Evidence in 1975 superseded the rigid "general acceptance" test established in Frye. Rule 702 created a flexible judicial gatekeeping role, enabling trial judges to evaluate scientific reliability using multiple empirical factors rather than relying solely on consensus.

89. (D) Updated regularly and securely retained for a defined period
ISO/IEC 17025 standards mandate that accredited testing laboratories systematically record, regularly update, and securely retain comprehensive equipment calibration and maintenance records for defined retention periods. Maintaining detailed maintenance logs provides essential metrological traceability, confirms equipment performance reliability, and supports technical quality audits required to prove measurement integrity during casework evaluations.

90. (A) The Court and justice administration
The paramount ethical and legal duty of a forensic science professional testifying in judicial proceedings is owed directly to the Court and the administration of justice. Regardless of administrative reporting structures or retaining organizations, expert witnesses must remain completely objective, presenting impartial scientific findings to assist the tribunal in discovering truth.

NODIA

CHAPTER 04

Crime Scene Management and Types of Crime Scenes

1. Which of the following best defines a crime scene in forensic investigation?
(A) Any physical location, person, or object that holds evidence regarding a crime
(B) Only the specific physical location where the core criminal act took place
(C) The police station where the First Information Report (FIR) is officially registered
(D) Only the location where the victim is found by the first responder

2. A murder takes place inside a house, and the perpetrator transports the body in a car to dump it in an agricultural field. In this scenario, what does the house represent?
(A) The secondary crime scene
(B) The microscopic crime scene
(C) The primary crime scene
(D) The conveyance crime scene

3. What is the primary forensic value of identifying a secondary crime scene?
(A) It may contain crucial physical evidence linking the suspect to the victim
(B) It provides the exact timeline of the original offence
(C) It helps in establishing the motive of the perpetrator
(D) It nullifies the evidentiary value of the primary crime scene

4. In crime scene management, what distinguishes a macroscopic crime scene from a microscopic crime scene?
(A) Macroscopic scenes only involve outdoor environments, whereas microscopic scenes are strictly indoor
(B) Macroscopic scenes are analysed by investigating officers, whereas microscopic scenes are analyzed solely by medical officers
(C) A macroscopic scene is visible only during the day, whereas a microscopic scene requires UV light
(D) The macroscopic scene is the overall physical location, whereas the microscopic scene consists of specific, localized pieces of trace evidence

5. Match the types of crime scenes in List I with their appropriate descriptions in List II.
List I: (Type of Crime Scene)
P. Primary Crime Scene
Q. Secondary Crime Scene
R. Conveyance Crime Scene
S. Clandestine Grave Site
List II: (Description)
1. A location where a body is illegally buried
2. A vehicle used in the commission of a crime
3. The location where the initial criminal act occurred
4. A subsequent location where evidence is found
(A) P-3, Q-4, R-2, S-1
(B) P-4, Q-3, R-1, S-2
(C) P-3, Q-4, R-1, S-2
(D) P-2, Q-1, R-4, S-3

6. Which of the following is an example of a passive crime scene?
(A) A bank where a robbery with a hostage situation is currently underway
(B) A building actively engulfed in flames suspected to be arson
(C) A locked house where a burglary occurred three days ago
(D) A highway where an ongoing high-speed pursuit is taking place

7. When preserving an outdoor crime scene in a rural area, such as an agricultural field, which environmental factor poses the most immediate threat to delicate trace evidence?
(A) The specific type of soil present in the agricultural field
(B) The presence of naturally occurring soil bacteria and microbes
(C) The specific agricultural crop currently being cultivated

Click Here to Buy book on Amazon

(D) Adverse weather conditions such as sudden rain or high wind

8. In an indoor crime scene, what is generally considered the most critical initial step for the investigating officer regarding scene boundaries?
(A) Securing all entry and exit points used by the suspect
(B) Opening all windows and doors to ensure adequate ventilation
(C) Sweeping the floor to locate macroscopic evidence
(D) Immediately applying latent print powder to all doorknobs

9. Why is a conveyance crime scene, such as a recovered stolen vehicle, often more complex to process than a typical indoor scene?
(A) Vehicles lack any suitable or stable surfaces for latent fingerprint recovery
(B) Vehicles can be moved, altering the environment and trace evidence
(C) Vehicles are legally classified as private property and cannot be searched at a scene
(D) Vehicles do not fall under the formal definition of a primary or secondary scene

10. Consider the following statements regarding underwater crime scenes:
I. Weapons found underwater should be dried immediately at the scene to prevent rusting.
II. Evidence recovered from water must be packaged in the same water to prevent rapid oxidation and degradation.
III. Underwater scenes are strictly considered secondary crime scenes.
Which of the above statement(s) is/are correct?
(A) I and II
(B) Only II
(C) I and III
(D) Only III

11. What is the primary forensic challenge in managing a mass disaster scene, such as a train derailment?
(A) Managing the extreme scale requiring standard DVI protocols
(B) Accurately locating and establishing the boundaries of the primary crime scene
(C) Preventing news media and journalists from arriving before the primary police team
(D) Securing and extracting volatile cyber evidence from all passengers' mobile phones

12. Arrange the following actions at an explosion and bomb blast scene in the correct chronological order of priority:
I. Securing the perimeter to preserve blast residues
II. Conducting a search for secondary explosive devices
III. Identifying the seat of the explosion (crater)
IV. Evacuating the injured and ensuring scene safety
(A) IV, II, I, III
(B) II, IV, I, III
(C) IV, I, II, III
(D) I, IV, III, II

13. At a suspected fire and arson scene, which specific area is of the utmost importance for the forensic expert to locate and examine first?
(A) The roof of the structure
(B) The electrical fuse box
(C) The least damaged room in the structure
(D) The point of origin of the fire

14. Which indicator is most commonly utilized during a preliminary search for a clandestine grave site in an outdoor setting?
(A) Elevated levels of carbon monoxide in the surrounding ambient air
(B) The widespread presence of scattered spent ammunition shell casings
(C) Vegetation differences and localized soil depression
(D) Abnormally high concentrations of gunshot residue on surrounding leaves

15. Consider the following statements regarding cyber crime scenes:
I. A powered-on computer should always be immediately unplugged from the wall to preserve data.
II. Volatile memory (RAM) is lost when the system is powered down.
III. The physical computer hardware is considered part of the crime scene.
IV. Mobile devices should be placed in Faraday bags to block remote wiping signals.
Which of the above statement(s) is/are correct?
(A) I, II, and III
(B) II, III, and IV
(C) I, III, and IV
(D) I, II, and IV

NODIA

16. In the context of criminal profiling and scene analysis, what characterizes a disorganised crime scene?
(A) The systematic use of physical restraints on the victim and a carefully hidden body
(B) Detailed evidence of meticulous offender planning and removal of the murder weapon
(C) The complete and total absence of any identifiable physical evidence or trace material
(D) Spontaneous execution and leaving the weapon at the scene

17. A perpetrator deliberately alters a crime scene prior to the arrival of police to misdirect the investigation, such as making a homicide appear as a suicide. What is this type of scene termed?
(A) A staged crime scene
(B) A simulated crime scene
(C) A disorganized crime scene
(D) A passive crime scene

18. What is the fundamental difference between a staged crime scene and a simulated crime scene in forensic terminology?
(A) Simulated scenes exclusively involve outdoor environmental locations, whereas staged scenes are strictly confined to indoor residential areas
(B) Staged scenes are strictly related to digital and cyber crimes, whereas simulated scenes exclusively involve acts of physical violence
(C) Staged scenes alter an actual crime, while simulated scenes fabricate an event entirely
(D) There is no fundamental legal or forensic difference; both terms are used interchangeably in trial courts and investigative manuals

19. When classifying a crime scene by the nature of the offence, which of the following directly dictates the specific type of forensic expert requested at the scene?
(A) The specific type of crime committed
(B) The precise time of day or night when the alleged offence occurred
(C) The total number of local police personnel available for deployment
(D) The level of public and media interest generated by the incident

20. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): The first responder at a crime scene must immediately cover a deceased body with a clean sheet or blanket found at the scene to maintain dignity.
Reason (R): Covering the body with items found at the scene prevents the introduction of external trace evidence.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

21. By definition, who is considered the first responder at a crime scene?
(A) The officially designated Crime Scene Manager appointed by the police department
(B) The first police officer or emergency official at the scene
(C) The senior forensic scientist dispatched from the State Forensic Science Laboratory
(D) The primary medical officer who subsequently conducts the post-mortem autopsy

22. Select the correct order of immediate priorities for a first responder arriving at a violent crime scene:
(A) Secure the overall scene → Search for trace evidence → Apprehend suspect → Provide first aid
(B) Ensure personal safety → Provide medical aid → Apprehend suspect → Secure scene
(C) Provide medical aid → Secure scene boundaries → Photograph evidence → Interview media personnel
(D) Secure the scene → Ensure personal safety → Interrogate all witnesses → Provide urgent medical aid

23. While preserving life is the highest priority at a crime scene, what action must the first responder take while medical personnel are treating the victim?
(A) Completely stop medical personnel from touching the victim until the official photographer arrives
(B) Immediately bag both hands of the victim before emergency transport in the ambulance
(C) Allow emergency medical personnel to move room furniture freely to create an optimal working space
(D) Note their path and instruct them to minimize scene alteration

Downloaded from www.pdf.tube

24. What is the primary objective of crime scene management?
(A) To preserve and record the scene to maximize evidence recovery
(B) To ensure a rapid legal conviction of the first potential suspect apprehended
(C) To provide immediate, detailed press releases to calm the public and media
(D) To clean up the affected area so normal daily activities can resume quickly

25. Consider the following statements regarding the inner and outer perimeters of a crime scene:
I. The inner perimeter encloses the area where the actual crime took place and where the most evidence is expected.
II. Only authorized investigative personnel should be allowed inside the inner perimeter.
III. The command post and media briefing area are strictly established within the inner perimeter for better observation.
Which of the above statement(s) is/are correct?
(A) I and III
(B) I and II
(C) II and III
(D) Only II

26. In the structure of a crime scene investigation team, what is the primary role of the Crime Scene Manager (CSM)?
(A) To personally collect, document, and package every individual piece of trace evidence
(B) To coordinate all forensic and investigative personnel at the scene
(C) To conduct the formal post-mortem autopsy examination of the deceased
(D) To present the final prosecution arguments before the judge in the courtroom

27. According to standard operating procedures for mobile forensic units, a complete crime scene investigation team typically includes which of the following combinations?
(A) Investigating Officer, Forensic Expert, Photographer, and Fingerprint Expert
(B) Superintendent of Police, District Magistrate, and Chief Medical Officer exclusively
(C) Cyber Crime Expert, Public Prosecutor, and official Police Media Liaison officer
(D) First Responding Constable, Emergency Paramedic, and legal Defence Counsel

28. What is the specific role of the Investigating Officer (IO) at a major crime scene?
(A) To personally conduct preliminary chemical spot tests on all suspected narcotic substances
(B) To perform disaster victim identification procedures on fragmented biological remains
(C) To maintain legal authority, guide investigation, and authorize evidence seizure
(D) To assess and repair structural damaged property resulting directly from the crime

NODIA

29. How does the role of the forensic expert differ from that of the Investigating Officer (IO) at a crime scene?
(A) The IO collects physical evidence, while the forensic expert is restricted to interviewing key witnesses
(B) The forensic expert is legally responsible for registering the FIR, while the IO processes the physical scene
(C) There is no practical difference; both roles are legally identical under the Bharatiya Nagarik Suraksha Sanhita
(D) The forensic expert provides scientific evidence analysis, while the IO holds overall command

30. Match the team members in List I with their primary on-scene responsibilities in List II.
List I: (Team Member)
P. First Responder
Q. Forensic Expert
R. Medical Officer
S. Photographer
List II: (Responsibility)
1. Determines time and cause of death during autopsy
2. Secures the initial scene boundaries
3. Creates a permanent visual record of unaltered evidence
4. Conducts presumptive blood testing and trace evidence collection
(A) P-2, Q-4, R-1, S-3
(B) P-1, Q-2, R-3, S-4
(C) P-2, Q-3, R-1, S-4
(D) P-4, Q-1, R-2, S-3

31. At what point should the photographer begin taking photographs of the crime scene?
(A) Only after all evidence has been collected and packaged
(B) Immediately upon arrival, before anything is moved or touched
(C) After the medical officer has turned the body over

(D) While the investigative team is actively dusting for fingerprints

32. What is the primary purpose of the initial briefing held at the crime scene before team entry?
(A) To immediately assign legal blame to potential suspects based on preliminary witness statements
(B) To formally inform representatives of the media about anticipated evidence and findings
(C) To complete final paperwork and formally release the crime scene back to the property owner
(D) To share facts, assess risks, and delegate tasks to team members

33. Where should the command post be ideally established at a major crime scene?
(A) In the outer perimeter or safe area outside the primary evidence zone
(B) Inside the primary crime scene boundary to maintain a continuous close watch on all physical evidence
(C) At the central administrative office of the nearest police station, completely away from the scene
(D) Inside the medical officer's specialized mobile ambulance unit parked directly near the scene

34. What is the main objective of a debriefing session after crime scene processing is complete?
(A) To verify administrative attendance and ensure all personnel have signed their daily timesheets
(B) To formally reprimand and penalize team members for administrative errors made during processing
(C) To review collected evidence, check for missed areas, and plan next steps
(D) To categorize and hand over all collected evidence items directly to the victim's family members

35. Consider the following statements regarding health and safety at a crime scene:
I. Eating, drinking, or smoking is strictly prohibited within the crime scene parameters.
II. A decontamination zone must be established for scenes involving hazardous chemicals.
III. Standard structural integrity checks are unnecessary before entering a blast scene.
IV. Nitrile gloves provide adequate protection against all types of corrosive acids.
Which of the above statement(s) is/are correct?
(A) I and II
(B) II and IV
(C) I, II, and III
(D) III and IV

36. Which item of Personal Protective Equipment (PPE) is most critical for preventing the secondary transfer of the investigator's own DNA to the crime scene evidence?
(A) Heavy-duty steel-toed tactical safety boots
(B) High-visibility reflective safety jacket or vest
(C) Heavy-duty leather industrial work gloves
(D) Face mask and nitrile gloves

37. When processing a violent crime scene with extensive blood spatter, which biohazard precaution is universally standard for forensic experts?
(A) Handling dried biological bloodstains without protective gloves once they appear completely dry
(B) Treating all bodily fluids as infectious for bloodborne pathogens
(C) Using an electric heat dryer to rapidly dry wet blood pools to prevent bacterial multiplication
(D) Thoroughly spraying the entire physical scene with formaldehyde chemical spray before entering

38. If a forensic expert encounters a pool of blood at a scene and requires a standard bleach solution for localized decontamination of dropped tools, what is the widely accepted dilution ratio of household bleach to water?
(A) 1:1
(B) 1:10
(C) 1:50
(D) 1:100

39. Which specialized crime scene kit must a forensic team utilize when responding to a suspected rape case to collect physical and trace evidence from the scene and the victim?
(A) Firearm and Gunshot Residue (GSR) Analysis Kit
(B) Comprehensive Arson and Accelerant Recovery Kit
(C) Chemical Cyanoacrylate Latent Fuming Kit
(D) Sexual Assault Evidence Collection Kit

Click Here to Buy book on Flipkart

40. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Maintaining a crime scene entry and exit log is an optional administrative procedure for minor thefts.
Reason (R): The log provides a documented record of every individual who entered the scene, which is essential to eliminate their fingerprints and DNA during later analysis.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

41. Who is strictly responsible for managing the media and public at the outer perimeter of a high-profile crime scene?
(A) The Director of the State Forensic Science Laboratory system
(B) The designated Public Relations Officer or senior police officer
(C) The first responding beat constable arriving at the incident scene
(D) The primary medical officer conducting the formal inquest proceeding

42. Select the correct sequence of fundamental crime scene processing steps:
(A) Collection → Sketching → Photography → Securing scene
(B) Securing scene → Photography → Sketching → Collection
(C) Sketching → Collection → Securing scene → Photography
(D) Photography → Securing scene → Collection → Sketching

43. Which of the following is considered a common and serious error in crime scene handling?
(A) Packaging wet, blood-soaked clothing in airtight plastic bags
(B) Changing gloves between collecting different items of evidence
(C) Taking mid-range and close-up photographs with a scale
(D) Establishing a single entry/exit path for all investigative personnel

44. Under standard criminal procedure (e.g., Bharatiya Nagarik Suraksha Sanhita / CrPC), which official has the primary legal authority to hold an inquest proceeding at a scene involving an unnatural death?
(A) The senior Forensic Expert attached to the mobile forensic laboratory unit
(B) The District Chief Medical Officer responsible for public health services
(C) The Sub-Inspector or Investigating Officer
(D) The District Magistrate or Executive Magistrate exclusively in all circumstances

45. Consider the following statements regarding the release of a crime scene:
I. A crime scene can be released temporarily and re-secured later without affecting the chain of custody.
II. The release of the scene must be authorized by the lead Investigating Officer.
III. A final survey or walk-through is conducted prior to releasing the scene to ensure no equipment or evidence is left behind.
Which of the above statement(s) is/are correct?
(A) I and II
(B) II and III
(C) I and III
(D) All I, II, and III

46. What constitutes the "chain of custody" in crime scene management?
(A) The yellow physical barrier tape and barricades deployed by police to secure scene boundaries
(B) The heavy metal chain locks used by investigators to physically secure a clandestine crime scene
(C) Documentation showing the seizure, custody, transfer, and analysis of evidence
(D) The formal administrative hierarchy and chain of command of police officers present at the scene

47. Which legal provision primarily governs the procedures for search and seizure by police officers, establishing the necessity of independent witnesses (Panchas) at the crime scene?
(A) Section 45 of the Indian Evidence Act / BSA
(B) Section 100 of the CrPC / Section 103 of BNSS
(C) Section 302 of the IPC / BNS
(D) Section 154 of the CrPC / BNSS

48. During a vehicle search at a conveyance crime scene, an investigator finds a suspected firearm under the driver's seat. What is the correct immediate action?

Downloaded from www.pdf.tube

(A) Pick it up by the barrel using a pen to check if it is loaded
(B) Unload the weapon immediately to make the scene safe
(C) Hand it to the ballistic expert for immediate test firing at the scene
(D) Photograph it exactly as found before moving or touching it

49. In a mass disaster scene where bodies are highly fragmented, what is the primary role of the forensic odontologist?
(A) To identify victims using dental records and bite mark analysis
(B) To determine the precise physical trajectory and blast velocity of secondary explosives
(C) To perform automated high-throughput DNA extraction directly from large liquid blood pools
(D) To interview surviving victims and eyewitnesses regarding the cause of the mass disaster

50. Match the forensic crime scene search patterns in List I with their typical applications in List II.
List I: (Search Pattern)
P. Grid Search
Q. Spiral Search
R. Strip/Line Search
S. Zone Search
List II: (Application)
1. Used in rooms or vehicles, dividing the area into manageable quadrants
2. Involves moving in concentric circles, often used in open water or fields
3. Best for large outdoor areas with multiple searchers moving in a straight line
4. A modified, double-line search providing thorough coverage of an area
(A) P-4, Q-2, R-3, S-1
(B) P-1, Q-2, R-3, S-4
(C) P-4, Q-3, R-2, S-1
(D) P-3, Q-1, R-4, S-2

51. When a forensic expert is sketching an indoor crime scene, they use the triangulation method. What does this method involve?
(A) Measuring distance from two fixed reference points
(B) Measuring an object's perpendicular distance from three different walls
(C) Drawing three separate detailed perspective sketches from different room angles
(D) Using a heavy triangular drafting ruler to draw perfectly straight boundary lines

52. Why must arson debris suspected of containing volatile accelerants be packaged in clean, airtight metal cans or special evidence bags?
(A) To prevent the spontaneous combustion of the evidence in transit
(B) To allow the evidence to completely dry out before lab analysis
(C) To protect the investigator from inhaling toxic fumes
(D) To prevent the evaporation of volatile petroleum distillates

53. If a forensic team encounters a highly putrefied body at a clandestine grave site, which biological evidence should be carefully collected from the soil surrounding the body to help estimate the time since death?
(A) Naturally occurring anaerobic soil microbes exclusively
(B) Entomological evidence like maggots and insects
(C) Fungal spores and microscopic mold growth colonies
(D) Subsurface root structures of nearby surrounding plants

54. At an outdoor crime scene, a footwear impression is found in soft mud. What is the standard procedure to preserve and collect this evidence?
(A) Spray the footwear mark with chemical luminol spray and swab the wet surface for latent residues
(B) Dig out the entire mud block intact and place it inside a sealed, heavy-duty plastic evidence bag
(C) Photograph it with a scale, then cast it using dental stone
(D) Press a specialized piece of high-absorbency filter paper firmly into the impression to lift it

55. What is the fundamental principle underpinning all crime scene investigations, stating that "every contact leaves a trace"?
(A) Galton's Principle
(B) Bertillon's Rule of Exchange
(C) The Principle of Individuality
(D) Locard's Exchange Principle

56. When establishing a crime scene perimeter, what is the general rule of thumb for defining the outer boundary?

NODIA

(A) Make it larger initially, as shrinking a perimeter is easier than expanding it
(B) Set the perimeter boundary at exactly 50 meters from the central focal point of the scene
(C) Strictly restrict the scene boundary to the specific room where the physical crime occurred
(D) Align it with legal property boundaries of the residence regardless of evidence scatter patterns

57. Which type of evidence is characterized by its high vulnerability to degradation, requiring immediate documentation and specialized recovery, such as digital footprints at a cyber crime scene?
(A) Non-porous evidence
(B) Volatile evidence
(C) Macroscopic evidence
(D) Circumstantial evidence

58. While processing a burglary scene, the forensic expert discovers a broken window. According to proper procedure, what must be done with the glass fragments?
(A) Glass fragments should be immediately swept up and discarded to prevent physical injury to the team
(B) Photograph them in situ, and package inside and outside fragments separately
(C) Only the single largest glass fragment should be collected and retained for physical fracture matching
(D) Fragments should be immediately glued back together at the scene to fully reconstruct the window frame

59. What is the primary purpose of taking "mid-range" photographs at a crime scene?
(A) To show the spatial relationship of an item of evidence to its surroundings
(B) To capture the overarching scene layout and exterior physical perimeter from the outside
(C) To show the minute, detailed ridge texture and characteristics of a fingerprint on glass
(D) To formally document and record the identities of all investigating team members present

60. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): At a simulated crime scene, the physical evidence often contradicts the statements given by the individual who reported the crime.
Reason (R): A simulated crime scene is intentionally fabricated by an individual to reflect an event that never actually occurred, leading to inconsistencies in forensic evidence.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

61. If a first responder arrives at a scene and finds the victim hanging from a ceiling fan, what is the most appropriate action if the victim is clearly deceased (rigor mortis present)?
(A) Immediately cut the deceased body down by untying the ligature knot tied around the neck
(B) Carefully cut the suspended rope in the middle to lower the body gently to the floor
(C) Cover the suspended hanging body entirely with a large, clean plastic protective sheet
(D) Secure the scene, leave the body as found, and await the IO and forensic team

62. In a blood-spattered indoor crime scene, what is the purpose of conducting a walk-through before initiating physical collection?
(A) To quickly gather and secure all visible weapons before members of the news media arrive
(B) To practice and rehearse the formal geometric search pattern that will be executed later
(C) To identify scene extent, plan a processing strategy, and set a safe path
(D) To thoroughly inspect and test structural floor stability throughout the indoor premises

63. Which basic crime scene equipment is essential for visualizing latent biological fluids like semen or saliva on bedsheets?
(A) High-intensity standard tactical flashlight
(B) An Alternate Light Source (ALS)
(C) Electromagnetic ground metal detector
(D) High-magnification optical glass lens

64. What is a "control sample" (or standard/ reference sample) collected at a crime scene?
(A) Any physical trace evidence deliberately or inadvertently left behind by the perpetrator

Click Here to Buy book on Amazon

(B) The very first physical piece of trace evidence collected by the lead Crime Scene Manager
(C) A specialized chemical presumptive reagent solution used to test for human bloodstains
(D) A sample of known origin for comparison against questioned evidence

65. Consider the following statements regarding the role of videography at a crime scene:
I. Videography can completely replace still photography as it captures continuous motion.
II. Audio recording should generally be disabled or minimized during crime scene videography to prevent capturing unprofessional comments.
III. Videography provides a smooth continuous flow of the scene layout, aiding courtroom presentations.
Which of the above statement(s) is/are correct?
(A) I and II
(B) II and III
(C) I and III
(D) Only III

66. When handling digital evidence, what is a "write-blocker" used for at a cyber crime scene?
(A) To prevent suspected remote actors from deleting or altering cloud files
(B) To automatically block unauthorized incoming emails from entering the network
(C) To read drive data without modifying or writing new data to it
(D) To decrypt complex password-protected system files almost instantaneously

67. During crime scene management, which search pattern is most suitable for a single forensic expert processing a small, rectangular bedroom?
(A) Strip/Line Search
(B) Systematic Grid Search
(C) Concentric Spiral Search
(D) Quadrant Zone Search

68. Which of the following is considered an active crime scene?
(A) A public park where a body was discovered early in the morning
(B) A commercial warehouse that burnt down completely two days ago
(C) A local cyber cafe where a major hacking incident occurred last week
(D) A bank where robbers are holding hostages

69. Why is a rough sketch drawn by an investigator at the scene considered forensically important, even when final scaled diagrams are generated later?
(A) It provides a more subjective and artistic visual interpretation of the physical crime scene
(B) It is created at the scene and contains original unedited measurements
(C) It legally eliminates the requirement for taking any formal photographic evidence later
(D) It is legally required to be submitted directly to media outlets for public release

70. Arrange the following steps of processing dried bloodstains found on a hard, non-porous floor in the correct procedural order:
I. Moistening a sterile cotton swab with distilled water
II. Photographing the stain with a scale
III. Swabbing the stain
IV. Air-drying the swab before packaging
(A) I, II, III, IV
(B) II, I, III, IV
(C) II, III, I, IV
(D) I, III, II, IV

71. If an investigator needs to collect trace evidence such as hair and fibers from a carpet at the scene, which method is most effective and minimizes contamination?
(A) Sweeping the entire carpet using a standard household broom
(B) Thoroughly cleaning and wiping the area using a wet cloth mop
(C) Carefully picking up individual visible strands with bare fingers
(D) Using forensic vacuum filters or tape lifting

72. Arrange the typical structure of a crime scene perimeter from the outermost boundary to the innermost point of evidence:
I. Inner Perimeter (Core Scene)
II. Outer Perimeter (Public/Media exclusion zone)
III. Command Post / Decontamination area
IV. Target/Focal Point (e.g., the body)
(A) II, III, I, IV
(B) I, II, III, IV
(C) II, I, III, IV
(D) III, II, I, IV

NODIA

73. Which type of PPE is absolutely essential to wear over standard footwear when processing a delicate indoor crime scene to avoid altering footprint evidence?
(A) Rubber protective gumboots
(B) Shoe covers
(C) Heavy leather work boots
(D) Standard bare feet

74. Which of the following statements about the admissibility of crime scene evidence under the Bharatiya Sakshya Adhiniyam (BSA) / Indian Evidence Act is incorrect?
(A) The chain of custody must be established to prove the evidence has not been tampered with
(B) A crime scene photograph is admissible even if the photographer cannot verify it
(C) Oral testimony of the forensic expert is admissible in court
(D) Expert opinion is considered relevant when the court has to form an opinion on a point of science

75. Match the regional Forensic Science Laboratories (FSLs) in List I with their location or jurisdiction in List II.
List I: (Forensic Science Laboratory)
P. State FSL Headquarters
Q. Regional FSL, Agra
R. Regional FSL, Varanasi
S. Regional FSL, Moradabad
List II: (Location / Jurisdiction)
1. Western UP / Braj region
2. Eastern UP / Purvanchal region
3. Lucknow
4. Rohilkhand region
(A) P-3, Q-1, R-2, S-4
(B) P-3, Q-2, R-1, S-4
(C) P-1, Q-3, R-2, S-4
(D) P-4, Q-1, R-3, S-2

76. What is the standard packaging material for biological evidence, such as a bloodstained shirt, collected at a crime scene?
(A) A sealed airtight plastic bag
(B) A glass jar with a tight lid
(C) A clean paper bag or envelope
(D) An aluminium foil wrap

77. At a hit-and-run scene, paint flakes from the suspect's vehicle are found on the victim's clothing. What is this type of evidence called?
(A) Biological Evidence
(B) Impression Evidence
(C) Digital Evidence
(D) Trace Evidence

78. In cases of explosion scenes, the forensic team is often assisted by which specialized police unit for neutralising remaining threats?
(A) Municipal Traffic Police Division
(B) Economic Offences Wing (EOW) investigative branch
(C) Bomb Disposal Squad (BDS)
(D) Specialized Cyber Crime Cell department

79. When an investigator uncovers a buried skeletal remain, why is it crucial to establish a grid system over the clandestine grave?
(A) To effectively prevent scavengers and wild animals from accessing or dispersing the exposed bones
(B) To map the exact spatial distribution and depth of bones and artefacts
(C) To quickly erect a structural tent framework to block direct sunlight and rain from the excavation area
(D) To allow multiple forensic investigators to dig rapidly and independently in different grid squares

80. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): A first responder must completely prohibit the victim's family members from entering the inner perimeter of a homicide scene, regardless of their emotional state.
Reason (R): Family members can inadvertently destroy trace evidence, cross-contaminate the scene, or intentionally remove incriminating items.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

81. Which item found at an indoor crime scene should ideally be dusted for latent fingerprints last, after all other forensic trace evidence (like fibers and DNA) has been collected?
(A) All non-porous surfaces
(B) A suspected murder weapon (knife)
(C) The carpet on the floor
(D) A drinking glass on a table

Downloaded from www.pdf.tube

82. Which of the following is considered a biohazard precaution specifically designed to protect the crime scene investigator from inhalation hazards at a clandestine drug laboratory?
(A) Wearing standard disposable latex medical gloves
(B) Wearing protective fluid-resistant shoe covers
(C) Using an appropriate respirator or SCBA
(D) Carrying an active personal digital radiation dosimeter

83. When first responding vehicles arrive at a fatal stabbing scene, what is their primary forensic responsibility?
(A) Securing scene boundaries and awaiting the IO and Forensic Team
(B) Collecting the weapon and transporting it immediately to the forensic lab
(C) Thoroughly washing blood off the victim to accurately locate the knife wound
(D) Interrogating all local public onlookers while avoiding entering the scene

84. Which of the following pieces of information is NOT typically recorded in the Crime Scene Entry and Exit Log?
(A) Name and agency of the individual entering
(B) Time of entry and time of exit
(C) Reason for entering the scene
(D) The individual's blood group

85. Consider the following statements regarding the duties of a Medical Officer at a crime scene:
I. The medical officer has the final authority on releasing the crime scene.
II. The medical officer's primary role at the scene is to pronounce death and estimate the preliminary time since death.
III. The medical officer should examine the body in a way that minimizes the destruction of trace evidence on the clothing.
IV. The medical officer is responsible for taking all crime scene photographs.
Which of the above statement(s) is/are correct?
(A) II and III
(B) I, II, and III
(C) II, III, and IV
(D) I and IV

86. During a crime scene briefing, the Investigating Officer specifies that it is a "disorganised" murder scene. What type of offender behavior does this suggest?
(A) High intellectual ability, meticulous preparation, and careful pre-offence planning
(B) A calculated execution performed by a professional hitman or contract killer
(C) Impulsive action, intoxication, and minimal attempt to conceal crime
(D) A complex, highly sophisticated cyber-attack targeting infrastructure systems

87. To prevent contamination when collecting multiple blood samples from different locations at a single scene, the forensic expert must:
(A) Use the exact same collection swab for all stains to consolidate evidence
(B) Thoroughly wash and rinse the swab with tap water between collections
(C) Package all wet biological swabs together inside a single plastic bag
(D) Change gloves and use a new sterile swab for each stain

88. Under what circumstance is the immediate physical removal of evidence by a first responder justified before the scene is fully photographed?
(A) If the weapon poses an immediate, active threat to life or safety
(B) If the item of evidence is a high-value asset such as large sums of cash or expensive jewelry
(C) If the first responder urgently wants to examine the object closely out of personal curiosity
(D) Immediate removal is strictly never legally justified under any investigative circumstance

89. A "staged" crime scene is often created by an offender to direct the investigation away from themselves. What is the most common motive behind staging a homicide as a burglary?
(A) To claim fraudulent property insurance money on allegedly stolen valuable items
(B) To explain forced entry and attribute death to a fictitious stranger
(C) To protect the victim's personal or professional reputation within the local community
(D) To intentionally increase dramatic media attention and press coverage on the incident

90. Which structural entity is responsible for the overall administrative control of the State Forensic Science Laboratory (FSL) and its regional units?
(A) The central Ministry of Home Affairs,

NODIA

Government of India
(B) Directorate of Forensic Science, Uttar Pradesh
(C) The executive Chief Minister's Office directly
(D) The specialized Central Bureau of Investigation

www.nodia.in

Click Here to Buy book on Flipkart

ANSWERS

1. (A) Any physical location, person, or object that holds evidence regarding a crime
A forensic crime scene encompasses any physical setting, individual, or item containing potential physical evidence related to an alleged offense. It is not limited to the central location of the criminal event. Identifying and securing all associated areas, objects, and persons ensures comprehensive recovery of biological, chemical, and physical evidence required for thorough scientific investigation.

2. (C) The primary crime scene
The primary crime scene is defined as the initial physical site where the original criminal act took place. In homicides involving body transportation, the residence where the actual assault or murder occurred constitutes the primary scene. Subsequent locations used for body disposal or transport represent secondary or conveyance scenes, which stem from the original event.

3. (A) It may contain crucial physical evidence linking the suspect to the victim
Secondary crime scenes hold significant forensic value because they often harbor critical physical evidence deposited after the initial offense. Objects such as vehicle interiors, secondary disposal sites, or hideouts frequently retain valuable trace materials, bodily fluids, footwear prints, or personal belongings that establish a direct physical link between the perpetrator, the victim, and the criminal sequence.

4. (D) The macroscopic scene is the overall physical location, whereas the microscopic scene consists of specific, localized pieces of trace evidence
Forensic crime scene classification differentiates between macroscopic and microscopic dimensions based on scale. The macroscopic scene refers to the entire physical environment, structural setting, or outdoor area where the criminal activity unfolded. Conversely, the microscopic scene involves specific localized areas containing minute trace evidence, such as individual bloodstains, fingerprints, hairs, fibers, or latent impressions.

5. (A) P-3, Q-4, R-2, S-1
Primary crime scenes represent the location of the initial criminal act. Secondary scenes encompass subsequent areas where associated physical evidence is recovered. Conveyance scenes specifically involve vehicles used during or after the offense to transport victims, suspects, or evidence. Clandestine grave sites are covert locations selected by offenders to illegally bury human remains and conceal evidence.

6. (C) A locked house where a burglary occurred three days ago
A passive crime scene is one where criminal activity has completely ceased, leaving behind physical evidence in a stable, unchanging state without ongoing threats or active movement. A locked residential structure following a past burglary exemplifies a passive scene, in contrast to active scenes that involve ongoing hazards, active flames, hostage situations, or ongoing pursuits.

NODIA

7. (D) Adverse weather conditions such as sudden rain or high wind
Outdoor crime scenes in agricultural fields are highly susceptible to rapid environmental degradation. Sudden rainfall can wash away water-soluble biological fluids, dilute chemical traces, and destroy fragile soil impressions. High winds can displace dust, fibers, biological debris, and particulate evidence. Protecting the scene from adverse weather is the most immediate priority for evidence preservation.

8. (A) Securing all entry and exit points used by the suspect
In an indoor crime scene investigation, controlling access points is paramount for scene integrity. Securing all doors, windows, and potential pathways utilized by the perpetrator prevents contamination, protects fragile latent impressions, and preserves trace evidence. Immediate boundary control ensures that external individuals do not disturb physical evidence present near the points of entry and exit.

9. (B) Vehicles can be moved, altering the environment and trace evidence
Conveyance scenes, such as motor vehicles, present unique forensic challenges due to mobility. Moving a vehicle alters physical relationships, induces mechanical vibrations, changes environmental exposure, and risks losing or cross-contaminating delicate trace evidence like hairs, fibers, and latent prints. Proper processing requires stabilizing the vehicle and meticulously documenting evidence before transport or environmental changes occur.

10. (B) Only II
Physical evidence recovered from submersed aquatic environments must remain immersed in the same water during packaging and transport. Exposing wet evidence to atmospheric oxygen causes rapid oxidation, rusting of metallic weapons, and destruction of delicate biological or chemical trace evidence. Drying evidence prematurely at the scene severely damages physical integrity and impairs subsequent laboratory analysis.

11. (A) Managing the extreme scale requiring standard DVI protocols
Mass disaster scenes involving widespread destruction present immense forensic challenges due to massive operational scale, chaotic environments, and multiple fatalities. Managing these complex incidents necessitates implementing standardized Disaster Victim Identification procedures. Systematic interdisciplinary protocols are essential to coordinate search, recovery, documentation, human identification, and evidence preservation across extensive physical boundaries involving numerous victims and scattered structural debris.

12. (A) IV, II, I, III
At an explosion scene, human life preservation and responder safety take absolute priority, beginning with evacuating victims and securing the immediate hazards. Investigators must then sweep the area for unexploded secondary explosive devices to prevent further casualties. Once safe, perimeter establishment preserves delicate chemical blast residues, followed by detailed search and identification of the blast crater.

NODIA

13. (D) The point of origin of the fire
In arson and fire scene investigations, locating the point of origin is the primary diagnostic step. The origin area typically contains the heaviest structural oxidation, burn patterns, and residues of volatile liquid accelerants used to initiate combustion. Detailed forensic examination of this specific zone allows investigators to distinguish accidental fires from intentional incendiary criminal acts.

14. (C) Vegetation differences and localized soil depression
Locating clandestine graves in outdoor environments relies heavily on recognizing physical surface anomalies. Disruption of natural soil strata creates visible surface depressions due to soil settling over time. Additionally, altered plant growth patterns, vegetation distress, or anomalous plant regrowth often signal underlying decomposition, nutrient changes, and past excavation activity, providing critical markers for forensic search teams.

15. (B) II, III, and IV
Digital crime scene processing requires preserving volatile data stored in random-access memory, which vanishes if power is severed improperly. Physical hardware components represent vital physical evidence containing stored digital traces. Placing mobile devices into signal-shielding Faraday enclosures prevents incoming wireless commands, remote data erasure, or network synchronization, maintaining digital evidence integrity during seizure and transport.

16. (D) Spontaneous execution and leaving the weapon at the scene
Disorganized crime scenes reflect impulsive, unplanned criminal acts executed without significant preparation. Perpetrators often act out of sudden emotion, anger, or intoxication, leaving behind chaotic scene patterns. Key indicators include leaving weapons at the location, failing to execute countermeasures, making minimal effort to avoid detection, and leaving abundant physical, biological, and impression evidence behind.

17. (A) A staged crime scene
A staged crime scene occurs when a perpetrator intentionally modifies the physical environment, victims, or evidence before law enforcement arrives. The objective of staging is to misdirect

the investigation, create a false narrative, protect the offender's identity, or simulate a different event entirely, such as disguising a violent homicide as a suicide or accidental death.

18. (C) Staged scenes alter an actual crime, while simulated scenes fabricate an event entirely
In forensic terminology, a staged crime scene involves altering a real, executed criminal act to mislead investigators regarding the true motive or perpetrator. In contrast, a simulated crime scene involves completely fabricating a criminal event that never actually took place, such as faking a burglary or assault to file false insurance claims or reports.

19. (A) The specific type of crime committed
The nature of the alleged criminal act directly determines the specialized expertise required for scene investigation. Different offenses demand distinct technical skills, such as arson specialists for fires, forensic ballistics experts for shootings, digital forensic examiners for cybercrimes, or forensic pathologists for homicides. Scene management depends on tailoring expert dispatch to the specific crime type.

20. (D) Assertion (A) is false but Reason (R) is true.
First responders must never cover a deceased body using materials found at the scene, as this introduces foreign trace evidence and disturbs preexisting physical evidence. However, using unexamined scene items introduces cross-contamination, which degrades physical evidence integrity. Consequently, preserving the body in its undisturbed state is mandatory until forensic experts document and examine the scene completely.

21. (B) The first police officer or emergency official at the scene
A first responder is defined as the initial police officer, emergency medical worker, or public safety official who arrives at the physical scene of an incident. Their immediate responsibilities include assessing hazards, rendering life-saving medical care, securing scene perimeters, detaining potential suspects, and preserving physical evidence until specialized investigative teams arrive.

22. (B) Ensure personal safety → Provide medical aid → Apprehend suspect → Secure scene
First responders must prioritize physical actions systematically upon arrival at a violent scene. Ensuring personal safety is the initial requirement, as injured personnel cannot assist others. Rendering immediate emergency medical aid to victims is the next priority. Subsequently, apprehending active suspects prevents further harm, followed by establishing secure perimeters to protect evidence integrity.

23. (D) Note their path and instruct them to minimize scene alteration
Preserving human life is the ultimate priority at any crime scene, necessitating rapid emergency medical intervention. While paramedics treat the victim, the first responder must observe and document the exact entry and exit routes taken by medical personnel. Instructing medical staff to avoid disturbing surrounding items minimizes scene alteration and preserves physical evidence integrity.

24. (A) To preserve and record the scene to maximize evidence recovery
Crime scene management focuses systematically on controlling, documenting, preserving, and processing physical environments associated with criminal activity. The primary objective is to maintain the pristine state of physical evidence, prevent contamination or loss, meticulously document physical relationships, and maximize the scientific recovery of trace, biological, and physical evidence for subsequent forensic evaluation.

25. (B) I and II
The inner perimeter encloses the focal point of criminal activity where physical evidence is concentrated. Strictly limiting inner perimeter entry to essential forensic and investigative personnel prevents scene contamination. Administrative structures, command posts, media briefings, and equipment storage must remain located in the outer perimeter or safe support zones outside the primary evidence area.

26. (B) To coordinate all forensic and investigative personnel at the scene
The Crime Scene Manager holds operational responsibility for directing and coordinating all investigative, scientific, and technical activities at the scene. This role involves organizing

Downloaded from www.pdf.tube

team workflow, managing resource allocation, maintaining communication among specialists, enforcing safety protocols, ensuring rigorous chain of custody procedures, and overseeing systematic scene documentation from initial entry through final scene release.

27. (A) Investigating Officer, Forensic Expert, Photographer, and Fingerprint Expert
Mobile forensic units require a balanced, multi-disciplinary team structure to handle diverse physical evidence effectively. Standard operational personnel include the lead Investigating Officer for legal authority, a Forensic Expert for scientific analysis, a crime scene Photographer for permanent documentation, and a Fingerprint Expert for latent friction ridge recovery and physical development procedures.

28. (C) To maintain legal authority, guide investigation, and authorize evidence seizure
The Investigating Officer maintains legal jurisdiction, administrative oversight, and overall command of the criminal investigation. Duties include directing police personnel, authorizing formal search and evidence seizure operations, interviewing witnesses, filing legal documentation, enforcing statutory compliance, and coordinating scientific findings provided by forensic specialists to establish the facts of the case.

29. (D) The forensic expert provides scientific evidence analysis, while the IO holds overall command
The operational roles of the forensic expert and the Investigating Officer are distinct yet complementary. The Investigating Officer exercises legal authority, leads the criminal investigation, and directs tactical operations. Conversely, the forensic expert provides objective scientific expertise, specializing in the technical recognition, documentation, collection, preservation, and scientific laboratory analysis of physical evidence.

30. (A) P-2, Q-4, R-1, S-3
First responders secure initial scene perimeters to preserve physical evidence. Forensic experts perform specialized tasks, including presumptive blood testing and trace evidence collection. Medical officers evaluate bodies and determine time and cause of death during formal autopsy examinations. Crime scene photographers capture unaltered visual records of physical evidence before collection.

31. (B) Immediately upon arrival, before anything is moved or touched
Forensic photography must begin immediately upon entry to record the crime scene in its original, untouched condition. Capturing comprehensive visual evidence before items are disturbed, moved, or collected preserves the exact spatial relationships and physical contexts of evidence, providing an authentic, objective visual record essential for subsequent investigation and court presentation.

32. (D) To share facts, assess risks, and delegate tasks to team members
An initial crime scene briefing aligns all operational personnel before physical entry. The meeting allows team leaders to review preliminary facts, evaluate biological or environmental hazards, establish safety protocols, designate entry pathways, and assign specific operational roles to specialists, ensuring structured, safe, and efficient scene processing while minimizing potential evidence contamination.

33. (A) In the outer perimeter or safe area outside the primary evidence zone
The operational command post must be located within the outer perimeter or secure support area, completely separated from the primary evidence zone. This positioning prevents unnecessary foot traffic, eliminates scene contamination, and provides a centralized location for administrative coordination, equipment staging, communications, and personnel management without disturbing delicate physical evidence.

34. (C) To review collected evidence, check for missed areas, and plan next steps
A post-investigation debriefing is conducted before releasing the crime scene to ensure processing completeness. Team members review documented evidence, confirm that all identified items have been collected, verify chain of custody logs, check for unexamined areas, address potential operational gaps, and coordinate subsequent investigative and laboratory action plans.

NODIA

35. (A) I and II
Consuming food, liquids, or tobacco at a crime scene is strictly prohibited to prevent DNA

contamination, scene alteration, and personal exposure to toxic hazards. For scenes involving chemical hazards, establishing dedicated decontamination zones protects personnel and equipment. Structural safety assessments at blast scenes are mandatory, and standard gloves fail against corrosive acids.

36. (D) Face mask and nitrile gloves
Personal Protective Equipment acts as a dual barrier during evidence collection. Wearing nitrile gloves and protective face masks prevents investigators from shedding epithelial cells, saliva droplets, or hair onto physical evidence, thereby preventing primary and secondary DNA contamination. Simultaneously, this equipment shields personnel from potential biohazardous materials present at the scene.

37. (B) Treating all bodily fluids as infectious for bloodborne pathogens
Standard biohazard protocols mandate treating all human blood and bodily fluids as potentially infectious for bloodborne pathogens such as hepatitis viruses and human immunodeficiency virus. Investigators must consistently utilize appropriate personal protective equipment, employ safe handling techniques, avoid artificial heat drying, and avoid chemical sprays that compromise physical and biological evidence.

38. (B) 1:10
A freshly prepared ten percent household bleach solution, representing a one-to-ten dilution ratio with water, is the standard forensic and medical disinfectant. This concentration effectively neutralizes viral and bacterial pathogens on non-porous tool surfaces and equipment without leaving destructive chemical residues that could compromise subsequent evidence processing.

39. (D) Sexual Assault Evidence Collection Kit
Investigating sexual assault cases requires specialized evidence collection kits containing standardized materials for gathering biological and physical evidence from victims, suspects, and scenes. These kits include sterile swabs, blood tube containers, comb tools, clothing bags, and documentation forms designed specifically to capture fragile biological traces, pubic hair, and seminal fluids.

40. (D) Assertion (A) is false but Reason (R) is true.
Maintaining a crime scene entry and exit log is a mandatory legal and procedural requirement for all crime scenes, regardless of offense severity. The log establishes an official record of every individual entering the area, providing accountability and enabling forensic laboratories to eliminate elimination fingerprints and DNA profiles during evidence analysis.

41. (B) The designated Public Relations Officer or senior police officer
Managing public information and media interactions at a major crime scene is strictly assigned to authorized personnel, such as a designated Public Relations Officer or appointed senior police officer. This structure ensures that accurate information is disseminated without compromising active investigations, breaching legal confidentiality, or disclosing sensitive evidence prematurely.

42. (B) Securing scene → Photography → Sketching → Collection
Forensic scene processing follows a strict chronological protocol to protect evidence integrity. First, investigators secure the perimeter to prevent contamination. Next, unbiased photographic records document unaltered evidence. Rough sketches with accurate measurements are created next to establish spatial relationships. Finally, systematic physical evidence collection and packaging take place.

43. (A) Packaging wet, blood-soaked clothing in airtight plastic bags
Sealing wet biological evidence, such as blood-soaked garments, in airtight plastic containers is a critical operational error. Trapped moisture fosters rapid fungal and bacterial growth, accelerating biological degradation and destroying DNA evidence. Biological items must be thoroughly air-dried at room temperature and packaged in breathable paper containers to preserve integrity.

44. (C) The Sub-Inspector or Investigating Officer
Under statutory criminal procedure provisions, an empowered police officer, typically holding the rank of Sub-Inspector or higher, possesses legal authority to conduct preliminary inquest proceedings in cases involving unnatural or suspicious deaths. The officer examines the body, documents physical conditions, records

Click Here to Buy book on Amazon

preliminary observations, and forwards the deceased for formal post-mortem examination.

45. (B) II and III
Releasing a crime scene requires formal authorization from the lead Investigating Officer after processing is complete. Prior to release, a final survey and walk-through ensure all equipment is retrieved and evidence collected. Re-securing a released scene later breaks the chain of custody, compromising the legal admissibility of subsequently gathered evidence.

46. (C) Documentation showing the seizure, custody, transfer, and analysis of evidence
The chain of custody represents unbroken written documentation tracking the life cycle of physical evidence. It records the exact date, time, identity, and purpose every time an item is collected, transferred, analyzed, or stored. Establishing an uninterrupted chain of custody proves that evidence presented in court is authentic and unaltered.

47. (B) Section 100 of the CrPC / Section 103 of BNSS
Section 100 of the Code of Criminal Procedure, corresponding to Section 103 of the Bharatiya Nagarik Suraksha Sanhita, governs statutory search and seizure procedures. It mandates that searches conducted by police officers must occur in the presence of independent local witnesses, known as Panchas, who attest to the search process and list seized evidence.

48. (D) Photograph it exactly as found before moving or touching it
Discovering a firearm inside a vehicle requires documenting its precise position and surrounding context before any physical handling occurs. Taking close-up and mid-range photographs in situ establishes exact spatial orientation, relation to surrounding vehicle components, and initial physical state, thereby preventing claims of evidence manipulation or accidental discharge before safety checks.

49. (A) To identify victims using dental records and bite mark analysis
In mass disaster scenarios involving severe fragmentation or burning of remains, forensic odontologists play a vital role in victim identification. By comparing post-mortem dental structures, dental work, and jaw morphology against pre-mortem dental records and radiographs, odontologists establish definitive human identities when visual or fingerprint identification is impossible.

50. (A) P-4, Q-2, R-3, S-1
Grid searches utilize double-line coverage for thorough exploration of complex areas. Concentric spiral patterns effectively cover open water or expansive fields. Strip or line search patterns suit large outdoor terrains with multiple searchers aligned systematically. Zone or quadrant searches divide enclosed indoor rooms or vehicle interiors into distinct manageable sectors for detailed inspection.

NODIA

51. (A) Measuring distance from two fixed reference points
The triangulation method in crime scene sketching fixes the precise location of an item by measuring straight-line distances from two permanent, immovable reference points, such as room corners or structural columns. These two measurements form a triangle with the evidence item, allowing exact spatial reconstruction in subsequent scaled diagrams.

52. (D) To prevent the evaporation of volatile petroleum distillates
Arson evidence suspected of containing liquid accelerants, such as gasoline or kerosene, must be sealed in clean, airtight metal containers or specialized vapor-impermeable bags. Standard paper or plastic packaging permits volatile petroleum distillates to evaporate and escape, preventing gas chromatography laboratory analysis from detecting and identifying residual accelerants.

53. (B) Entomological evidence like maggots and insects
When decomposing human remains are recovered from clandestine graves, collecting forensic entomological evidence from surrounding soil is critical. Analyzing insect species, larval developmental stages, and blowfly maggot activity provides vital biological data. This scientific analysis enables forensic entomologists to calculate the minimum post-mortem interval and accurately estimate time elapsed since death.

54. (C) Photograph it with a scale, then cast it using dental stone
Three-dimensional impression evidence, such as footwear prints in soft mud, requires initial scale photography placed parallel to the impression surface. Following photographic recording, the impression is preserved by pouring dental stone casting material into the mark. Casting creates a rigid, three-dimensional physical replica capturing fine tread features and individual wear characteristics.

55. (D) Locard's Exchange Principle
Locard's Exchange Principle forms the foundational scientific concept of modern forensic science, stating that every contact leaves a trace. Whenever an individual enters a physical setting or interacts with an object, a cross-transfer of microscopic materials occurs, resulting in the reciprocal exchange of physical, biological, or chemical trace evidence between entities.

56. (A) Make it larger initially, as shrinking a perimeter is easier than expanding it
When establishing initial crime scene boundaries, investigators follow the operational principle of securing an expansive outer perimeter. Setting a larger initial boundary ensures that scattered trace evidence and secondary points of interest remain protected from public intrusion. Reducing a perimeter size later is straightforward, whereas expanding a compromised perimeter risks evidence loss.

57. (B) Volatile evidence
Volatile evidence refers to physical or digital trace materials that undergo rapid loss, decay, or alteration if not secured immediately. Examples include volatile liquid accelerants, transient environmental odors, short-lived biological traces, and electronic data stored in volatile RAM, all of which require prompt documentation, specialized recovery techniques, and swift preservation.

58. (B) Photograph them in situ, and package inside and outside fragments separately
Glass fragment evidence at a burglary scene requires initial in situ documentation through photographs depicting spatial layout. To determine the direction of force and impact origin, fragments found on the inside and outside of the entry structure must be collected and packaged in separate, labeled rigid containers to prevent intermixing and breakage.

59. (A) To show the spatial relationship of an item of evidence to its surroundings
Mid-range forensic photography establishes the spatial relationship between a specific piece of evidence and fixed environmental landmarks within the scene. Positioned between overall perspective photos and close-up detail shots, mid-range views provide necessary spatial context, demonstrating where evidence items are located relative to structural features and other physical objects.

60. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
In simulated crime scenes, an individual fabricates a fictitious incident to mislead investigators or conceal an unrelated motive. Because the physical scene is artificially manipulated, forensic analysis reveals physical contradictions, missing trace evidence, or unnatural physical patterns that directly conflict with the reporting party's verbal statements and narrative of events.

61. (D) Secure the scene, leave the body as found, and await the IO and forensic team
When a first responder arrives at a scene and confirms that a suspended individual is unequivocally deceased, the body must remain undisturbed. Cutting ropes or altering ligature attachments destroys critical impression evidence and knots. Securing the boundary and preserving the exact position allows the forensic team to examine hanging mechanics properly.

62. (C) To identify scene extent, plan a processing strategy, and set a safe path
The initial walk-through provides investigators with a preliminary assessment of the physical environment before processing begins. This systematic inspection establishes the total extent of the scene, identifies fragile evidence requiring immediate protection, determines appropriate search strategies, and establishes a designated safe focal path to prevent contamination during subsequent operations.

63. (B) An Alternate Light Source (ALS)
An Alternate Light Source utilizes specific narrow wavelengths of light coupled with selective excitation filters to visualize latent biological evidence. Fluids such as semen, saliva, and urine exhibit inherent natural fluorescence under specific light frequencies, enabling investigators to locate, document, and collect trace stains

Downloaded from www.pdf.tube

on absorbent surfaces like bedsheets without chemical alteration.

64. (D) A sample of known origin for comparison against questioned evidence
A control or reference sample represents physical material gathered from a known, verified source for scientific comparison against questioned evidence collected at a crime scene. Comparing unknown trace materials to known reference samples allows laboratory analysts to establish physical identity, origin, or exclusion during forensic evaluation and legal proceedings.

65. (B) II and III
Videography serves as a valuable tool for demonstrating spatial layout and scene continuity in court, but it complements rather than replaces still photography. Audio recording is generally muted to prevent recording non-essential side conversations or unverified opinions, ensuring that the video remains an objective visual record of the physical scene.

66. (C) To read drive data without modifying or writing new data to it
In digital forensics, a write-blocker is a hardware or software device that permits investigators to examine and acquire digital data from storage media while physically preventing write commands. By blocking data modifications, write-blockers preserve the exact original state of digital evidence, maintaining evidentiary integrity and ensuring compliance with forensic standards.

67. (A) Strip/Line Search
The strip or line search pattern is highly effective when a single investigator processes a small, defined area, such as a rectangular bedroom. The searcher moves along parallel lanes across the room in one direction, ensuring complete visual coverage without missing areas or creating unnecessary physical overlap that could disturb delicate scene context.

68. (D) A bank where robbers are holding hostages
An active crime scene involves ongoing criminal activity, immediate physical threats, active perpetrators, or rapidly changing hazards. A bank robbery with an active hostage situation exemplifies an active scene, requiring tactical police intervention and crisis management to neutralize ongoing threats and ensure safety before scientific forensic processing can safely commence.

NODIA

69. (B) It is created at the scene and contains original unedited measurements
A rough crime scene sketch is forensically vital because it is generated directly at the location during processing, capturing original, unedited physical dimensions, spatial relationships, and item locations. Unlike post-processed scaled diagrams created later, the rough sketch reflects authentic, contemporaneous documentation made before any scene alteration or evidence movement.

70. (B) II, I, III, IV
Collecting dried biological stains on non-porous surfaces follows a precise sequence. First, scale photography documents the undisturbed stain in situ. Next, a sterile cotton swab is moistened with distilled water. The stain is then swabbed thoroughly. Finally, the wet swab is air-dried before final packaging to prevent enzymatic degradation.

71. (D) Using forensic vacuum filters or tape lifting
Recovering minute trace evidence, such as hairs and textile fibers from textile materials, requires specialized non-destructive collection techniques. Utilizing adhesive tape lifts or specialized forensic vacuum systems equipped with trace filter traps ensures efficient gathering of microscopic materials across wide surfaces while minimizing cross-contamination and preserving delicate physical structural integrity.

72. (A) II, III, I, IV
Crime scene architecture follows a concentric structure moving inward toward the focal point. The outer perimeter forms the external exclusion boundary against public intrusion. Moving inward, intermediate zones accommodate command posts and decontamination facilities. The inner perimeter encloses the primary evidence zone, which culminates at the target focal point of the crime.

73. (B) Shoe covers
Disposable shoe covers worn over standard footwear are essential Personal Protective Equipment during indoor scene processing. They prevent investigators from introducing foreign soil, dirt, or debris into the scene and eliminate cross-contamination. Crucially, shoe

covers protect existing footwear impressions and prevent investigators' sole patterns from leaving misleading friction prints.

74. (B) A crime scene photograph is admissible even if the photographer cannot verify it
Under statutory evidence laws, photographic evidence is admissible in court only when authenticated by the photographer or a witness who can verify its accuracy and fair representation of the scene. Unverified photographs lacking authenticating testimony or clear chain of custody documentation fail legal standards of admissibility regarding scientific proof.

75. (A) P-3, Q-1, R-2, S-4
Forensic laboratory infrastructure in Uttar Pradesh includes the State FSL Headquarters located in Lucknow. Regional FSL facilities serve specific regional jurisdictions across the state: Agra covers the Western UP and Braj region, Varanasi manages the Eastern UP Purvanchal region, and Moradabad oversees scientific requirements for the Rohilkhand regional administrative division.

76. (C) A clean paper bag or envelope
Biological evidence, such as bloodstained garments, must be packaged in breathable paper bags or paper envelopes after thorough air-drying. Paper allows moisture evaporation, preventing anaerobic bacterial growth, fungal molding, and chemical breakdown of cellular DNA. Airtight plastic containers retain humidity, causing rapid bacterial destruction of biological evidence during storage.

77. (D) Trace Evidence
Microscopic materials transferred during physical contact between objects or individuals are classified as trace evidence under Locard's Exchange Principle. Paint flakes transferred from a vehicle onto a victim's clothing in hit-and-run incidents represent trace evidence, requiring microscopic, physical fracture, and chemical analysis to link suspect vehicles to crime scenes.

78. (C) Bomb Disposal Squad (BDS)
Explosion scenes present immediate operational hazards from unexploded secondary explosive devices and unstable structural debris. Forensic investigation teams collaborate closely with specialized Bomb Disposal Squads to perform initial sweeps, identify unexploded ordnance, render hazardous devices safe, and secure the physical environment before forensic experts enter to collect blast residues.

79. (B) To map the exact spatial distribution and depth of bones and artefacts
Establishing a systematic coordinate grid system over a clandestine grave site is essential for archaeological excavation protocols. Gridding allows forensic excavators to record, photograph, and map the precise three-dimensional spatial orientation, relative depth, and exact distribution of skeletal remains, personal belongings, and associated physical artifacts prior to recovery.

80. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
First responders must strictly prohibit unauthorized individuals, including grieving family members, from entering inner crime perimeters. Despite emotional distress, non-investigative entry introduces severe contamination risks, such as depositing foreign DNA, altering footprint impressions, disturbing scene context, or accidentally or intentionally destroying critical physical evidence needed for prosecution.

81. (A) All non-porous surfaces
Processing non-porous surfaces for latent fingerprints using physical fingerprint powders must occur after collecting fragile trace evidence such as DNA, hairs, and textile fibers. Applying fingerprint powders or chemical powders exerts physical mechanical force, which can easily displace, contaminate, or destroy delicate microscopic traces present on non-porous objects.

82. (C) Using an appropriate respirator or SCBA
Clandestine drug laboratories present severe chemical hazards, including volatile organic solvents, corrosive acid vapors, toxic gases, and airborne particulates. To protect investigators from acute inhalation injury and systemic chemical poisoning, personnel must wear appropriate respiratory protection, such as full-face air-purifying respirators or self-contained breathing apparatus, before entering hazardous environments.

83. (A) Securing scene boundaries and awaiting the IO and Forensic Team
Upon arriving at a fatal stabbing scene where the victim is confirmed dead, first responders

Click Here to Buy book on Flipkart

must focus on establishing scene security. Responsibilities include setting up perimeters, controlling entry points, safeguarding physical evidence from environmental disruption or tampering, and preserving scene integrity while awaiting the arrival of the lead Investigating Officer and scientific team.

84. (D) The individual's blood group
A Crime Scene Entry and Exit Log tracks operational personnel accessing the secured perimeter. Required entries include full names, organizational agencies, exact arrival and departure times, and specific operational reasons for entry. Personal biological data, such as an individual's blood group, is irrelevant to scene security logs and is not recorded.

85. (A) II and III
At a crime scene, the Medical Officer pronounces death, evaluates preliminary post-mortem changes to estimate time since death, and inspects the body carefully to avoid disturbing biological trace evidence on clothing. Releasing the scene remains the sole authority of the lead Investigating Officer, while scene photography is conducted by designated forensic photographers.

86. (C) Impulsive action, intoxication, and minimal attempt to conceal crime
A disorganized crime scene reflects offender behavior characterized by sudden impulse, lack of planning, emotional agitation, or severe intoxication. Indicators include unplanned violence, leaving weapons or trace evidence at the scene, making minimal attempts to hide evidence, and exhibiting chaotic, destructive behavior patterns without structural execution or deliberate concealment strategies.

87. (D) Change gloves and use a new sterile swab for each stain
To avoid cross-contamination when collecting multiple biological samples across a crime scene, forensic personnel must exercise strict hygienic protocols. Investigators must change disposable gloves between individual evidence items and utilize a fresh, sterile collection swab for each separate biological stain, preserving sample purity for subsequent laboratory DNA analysis.

88. (A) If the weapon poses an immediate, active threat to life or safety
Moving physical evidence before complete photographic documentation is generally prohibited, but emergency exceptions exist when life safety is compromised. If an unrecovered weapon poses an immediate, active hazard to responders or the public, a first responder is justified in securing the item safely, noting its original position precisely for investigative records.

89. (B) To explain forced entry and attribute death to a fictitious stranger
Staging a homicide scene to resemble a residential burglary is a calculated tactic used by perpetrators known to the victim. By creating artificial signs of forced entry, disturbing household contents, and fabricating theft evidence, the offender seeks to misdirect investigators toward an unknown intruder, thereby diverting suspicion from themselves.

90. (B) Directorate of Forensic Science, Uttar Pradesh
Administrative governance, operational management, and structural oversight of the State Forensic Science Laboratory and its regional branches reside under the Directorate of Forensic Science, Uttar Pradesh. This administrative body regulates forensic facilities, manages resource allocation, enforces technical standardization, and oversees forensic service delivery across investigative agencies within the state jurisdiction.

www.nodia.in

Downloaded from www.pdf.tube

CHAPTER 05

Securing, Protecting and Searching the Crime Scene

NODIA

1. What is the primary objective of the first responding police officer when securing a crime scene?
(A) To immediately begin collecting fragile physical evidence
(B) To preserve life and secure the area from unauthorized access
(C) To interview all witnesses and suspects present
(D) To sketch the scene before any evidence is moved

2. How is the outer perimeter of a crime scene ideally determined by the first responder?
(A) By measuring a standard 50-metre radius from the primary focal point
(B) By strictly following the property lines of the premises
(C) By isolating only the room where the crime was committed
(D) By encompassing the focal point, all suspected entry/exit paths, and secondary scenes

3. What is the purpose of establishing a single path of entry and exit at a crime scene?
(A) To minimize the risk of contamination and destruction of evidence by personnel
(B) To allow media personnel a designated viewing area
(C) To deliberately trap any suspects still hiding in the premises
(D) To speed up the extraction of the deceased by medical teams

4. In a three-tier cordon system, which of the following is permitted inside the 'Inner Cordon'?
(A) Authorized media personnel and local politicians
(B) Police personnel acting as perimeter guards and evidence loggers
(C) Only designated crime scene investigators and essential forensic experts
(D) First-aid providers treating minor injuries of bystanders

5. The physical barrier most commonly used by police and forensic teams to establish a temporary visible perimeter at outdoor crime scenes is:
(A) Brightly coloured police barrier tape
(B) Heavy-duty portable chain-link fencing
(C) High-density concrete highway barriers
(D) Plain twisted synthetic rope cordons

6. Which of the following best defines 'cross-contamination' in the context of forensic crime scene searching?
(A) The natural degradation of biological evidence caused by environmental weather conditions
(B) The intentional destruction of physical evidence by a suspect before police officers arrive
(C) The failure to log the entry and exit of an investigating police officer at the scene
(D) The transfer of trace material from one distinct item of evidence to another

7. Match the cordon zones in List I with their primary function or occupants in List II.
List I: (Cordon Zone)
P. Inner Cordon
Q. Intermediate Cordon
R. Outer Cordon
S. Crime Scene Log Area
List II: (Function/Occupants)
1. Boundary keeping the general public and media out
2. Checkpoint usually located at the entry to the intermediate zone
3. Area restricted solely to forensic experts working on evidence
4. Staging area for equipment and command post
(A) P-1, Q-2, R-3, S-4
(B) P-3, Q-4, R-1, S-2
(C) P-4, Q-3, R-2, S-1
(D) P-3, Q-1, R-4, S-2

8. Which of the following is a primary source of contamination by investigating officers during a crime scene search?
(A) Using a tripod to stabilize a camera during initial scene photography
(B) Placing numbered plastic evidence markers adjacent to discovered items
(C) Shedding natural hair or respiratory droplets directly onto evidence
(D) Measuring room dimensions using a modern electronic laser distance meter

9. Why is the use of anti-contamination clothing (such as Tyvek suits, gloves, and masks) mandatory for Scientific Assistants during scene processing?
(A) To protect the investigator from extreme weather conditions
(B) To clearly identify the ranks of the officers present at the scene
(C) To ensure compliance with general uniform regulations of the police department
(D) To prevent the investigator's own DNA and fibres from mixing with scene evidence

10. Transient evidence requires immediate protection or documentation because it is easily lost. Which of the following is an example of transient evidence?
(A) The smell of unburnt petrol in an arson case
(B) A fired 9mm cartridge case on a concrete floor
(C) A deep axe impression on a wooden door frame
(D) A bloodstain on a cotton bedsheet

11. If a heavy rainstorm begins while forensic experts are searching an outdoor crime scene, what is the best immediate action to protect biological evidence?
(A) Cover the evidence immediately with non-porous plastic sheeting securely anchored with heavy sandbags
(B) Erect a waterproof pop-up tent or umbrella structure over it that preserves surrounding air circulation
(C) Thoroughly rinse the evidence with distilled water immediately to prevent rainfall from washing it unevenly
(D) Postpone all forensic search activities and wait patiently for the storm to completely pass before taking action

12. Processing a complex outdoor crime scene at night presents significant risks of missing evidence. If adequate artificial lighting is unavailable, the standard forensic protocol is to:
(A) Conduct a rapid preliminary search using hand-held battery flashlights to save time
(B) Secure and guard the scene until daylight allows for a comprehensive search
(C) Retrieve only prominent physical items and skip the time-consuming search for trace evidence
(D) Deploy thermal imaging equipment to identify and locate all categories of physical evidence

13. What is the primary function of maintaining a Crime Scene Entry/Exit Log?
(A) To record the identity, time, and purpose of all personnel entering the area
(B) To calculate overtime allowances and hazard pay for police officers deployed at the scene
(C) To establish the exact timeline and minute-by-minute account of when the suspect committed the offense
(D) To maintain a comprehensive property inventory of all physical items seized during the search

14. Consider the following statements regarding medical emergencies at a crime scene:
I. Saving the life of a victim always takes precedence over the preservation of physical evidence.
II. First responders must never enter the scene to administer first aid until the forensic team has photographed the victim.
III. The path taken by medical personnel should be noted and communicated to the investigating officers.
Which of the above statement(s) is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

15. Unauthorized entry into the inner cordon of a crime scene by curious public or off-duty police officers most directly violates which fundamental forensic concept?
(A) Bertillon's Rule of Measurement
(B) The Principle of Individuality
(C) The Chain of Custody
(D) Locard's Exchange Principle

Click Here to Buy book on Amazon

16. What is the fundamental objective of conducting a systematic crime scene search?
(A) To locate valuable personal property that can later be auctioned by the investigating police department
(B) To rapidly sanitize and restore the location so that the rightful property owner can immediately return
(C) To locate, identify, and document all physical evidence relevant to the crime
(D) To reconstruct the exact chronological sequence of criminal actions without relying on laboratory analysis

17. Which search method is generally considered most effective for a large, open outdoor area such as an agricultural field?
(A) Point-to-point search
(B) Strip or line search
(C) Outward spiral search
(D) Wheel search

18. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): The grid search method is highly thorough but extremely time-consuming.
Reason (R): In a grid search, the search area is covered twice by intersecting parallel strips at right angles.
Which of the following is correct?
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(B) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

19. An inward spiral search pattern typically begins:
(A) At the outer perimeter of the search area and spirals inward toward the centre
(B) At the primary focal point or centre of the scene and steadily spirals outward toward the outer boundary
(C) At a chosen corner of an enclosed room, traversing systematically back and forth across the entire floor
(D) By partitioning the designated crime scene layout into four distinct, manageable equal quadrants

20. Which crime scene search pattern divides the scene into manageable, distinct sections (often used for houses or vehicles) which are then searched individually?
(A) Double-strip grid method
(B) Inward or outward spiral method
(C) Zone or quadrant method
(D) Radial wheel or ray method

21. In which scenario is the outward spiral search method most appropriately applied?
(A) Evidence radiates from a central focal point, such as an explosion
(B) Systematic searches conducted across multiple floors of a commercial office building
(C) Recovery operations aimed at locating a drowning victim in a fast-moving river current
(D) Surface searches covering an extended distance along a narrow highway shoulder

22. The wheel or radial search pattern requires searchers to start at the centre and move outwards along linear paths. A major disadvantage of this method is that:
(A) Search personnel are highly likely to inadvertently trample and destroy physical evidence at the central point prior to commencing
(B) Performing this specific search pattern strictly requires the continuous deployment of specialized heavy technological equipment
(C) Findings obtained using this pattern are automatically deemed legally inadmissible as primary evidence under current statutory provisions
(D) Gaps between search paths expand as searchers move outward, creating unsearched spaces

23. The 'point-to-point' search method involves moving systematically from one piece of visible evidence to the next. Why is this method generally discouraged for comprehensive crime scene processing?
(A) Executing this specific pattern requires an excessively large number of trained search personnel
(B) It overlooks areas between visible items where latent evidence may exist
(C) The procedure can only be validly executed during nighttime hours with specialized Alternate Light Sources
(D) Completing a full point-to-point sweep

NODIA

consumes far more time and physical effort than conducting a grid search

24. When conducting a search of an indoor room where a violent assault occurred, a Scientific Assistant should ensure that the search includes:
(A) Strictly the ground floor area, based on the assumption that gravity causes all physical material to fall downward
(B) Exclusively the immediate two-foot perimeter area surrounding the original resting location of the victim's body
(C) The floor, walls, and ceiling to locate blood spatter and projectiles
(D) Only the primary entrance doorways and emergency exit points connected to the enclosed room where the assault occurred

25. While executing a strip or line search in a densely wooded area, what is a crucial requirement for the search team?
(A) Searchers should vary their walking speeds and viewing angles to maximize coverage of dense vegetation
(B) Every individual member of the search line must continuously operate a handheld metal detection device
(C) Searches must be conducted exclusively during nighttime hours utilizing high-intensity tactical flashlights
(D) They must maintain a straight line, equal spacing, and a uniform pace

26. Select the most logical sequence for searching a vehicle suspected of being used in a crime:
(A) Search the exterior → Search the undercarriage → Search the interior cabin → Search the trunk
(B) Search the interior cabin → Search the trunk → Search the exterior → Search the undercarriage
(C) Search the undercarriage → Search the exterior → Search the interior cabin → Search the trunk
(D) Search the trunk → Search the undercarriage → Search the exterior → Search the interior cabin

27. Under which legal authority in India can a police officer mandate the search of an arrested suspect's person to collect forensic evidence?
(A) Section 154 of the Bharatiya Nagarik Suraksha Sanhita (BNSS)
(B) Section 50 of the Bharatiya Nagarik Suraksha Sanhita (BNSS)
(C) Section 120B of the Bharatiya Nyaya Sanhita (BNS)
(D) Section 45 of the Bharatiya Sakshya Adhiniyam (BSA)

28. Underwater crime scene searches to recover weapons or bodies are typically conducted by specialized divers. Which of the following patterns is commonly adapted for underwater searches in low visibility?
(A) High-speed aerial photogrammetry drone scanning over open water surfaces
(B) Arc sweep search using a tether line anchored to a central weight
(C) Free-floating unanchored point-to-point underwater search by independent divers
(D) Uncontrolled outward spiral swimming patterns without physical tether guides

29. Which of the following is considered an improper practice when excavating buried skeletal remains?
(A) Digging directly into the grave using heavy backhoes
(B) Carefully excavating soil in thin, uniform horizontal layers while recording stratigraphy
(C) Systematically screening all excavated soil through fine mesh sieves to retrieve small bones or dental fragments
(D) Meticulously documenting soil horizon variations, wall profiles, and visible tool marks inside the excavation pit

30. A metal detector used at a crime scene operates by sensing:
(A) Chemical residues and volatile compounds left behind by recently discharged gunpowder
(B) Infrared thermal heat signatures emitted by metallic weapons after being recently fired
(C) Anomalies in electromagnetic fields caused by conductive metallic objects
(D) Specific gravity differential signatures characteristic exclusively of lead bullet fragments

31. Consider the following statements regarding the use of Ground Penetrating Radar (GPR) at a crime scene:
I. GPR is used to detect subsurface anomalies such as clandestine graves or buried weapons.
II. GPR requires absolute physical destruction of the topsoil to function.
III. GPR emits radio waves into the ground and

Downloaded from www.pdf.tube

records the reflected signals.
IV. High moisture or clay-heavy soils can negatively affect GPR depth penetration.
Which of the above statement(s) is/are correct?
(A) I, II, and III
(B) II, III, and IV
(C) I, III, and IV
(D) I, II, and IV

32. Which specific target odour are 'cadaver dogs' (Human Remains Detection dogs) trained to locate during a forensic search?
(A) Traces of unburned energetic compounds and explosive chemicals such as RDX, PETN, or TNT
(B) Unique epidermal sweat gland secretions and specific stress pheromones of a fleeing suspect
(C) Volatile organic compounds specific to human decomposition
(D) Specific metallic oxidation odours given off by oiled iron, steel, or brass buried firearms

33. An Alternate Light Source (ALS) assists in searching for latent evidence by utilizing which optical phenomenon?
(A) Diffraction and dispersion of visible white light passing through clear optical glass elements
(B) Absorption and fluorescence of biological fluids at specific light wavelengths
(C) Total internal refraction and scattering of coherent light rays travelling through deep water bodies
(D) Direct specular reflection of near-infrared wave frequencies off synthetic textile fibre matrices

34. What is the primary benefit of using drones (UAVs) equipped with cameras during the initial search of a large-scale disaster or crime scene?
(A) They perform rapid, fully automated field analysis of biological DNA samples detected on ground surfaces
(B) They completely eliminate any legal or operational requirement for ground personnel to physically enter the scene
(C) They are mandated as a mandatory legal prerequisite for investigating any outdoor crime scene
(D) They provide high-resolution aerial photogrammetry for accurate 3D mapping

NODIA

35. Under the Bharatiya Nagarik Suraksha Sanhita (BNSS), a search warrant for a private premises is generally issued by:
(A) A Magistrate having proper jurisdiction
(B) A Sub-Inspector of Police
(C) The Director of the State Forensic Science Laboratory
(D) The complainant in the FIR

36. Arrange the following fundamental steps of processing and searching a crime scene in the correct chronological order:
I. Conducting a systematic physical search
II. Securing and isolating the scene
III. Photographing and sketching the evidence in place
IV. Collecting and packaging the evidence
Select the correct order:
(A) II, III, I, IV
(B) I, II, III, IV
(C) II, I, III, IV
(D) II, I, IV, III

37. What is the standard purpose of placing numbered or lettered plastic evidence markers next to items discovered during a search?
(A) To show evidence locations in photos and sketches prior to collection
(B) To provide field investigators with an initial estimate of the commercial monetary value of seized items
(C) To indicate clearly to responding emergency medical personnel which specific items remain biologically sterile
(D) To definitively establish the precise chronological sequence in which the perpetrator physically touched various objects

38. In a well-coordinated crime scene team, the individual responsible for strictly documenting the location of all evidence relative to fixed reference points is the:
(A) Lead Crime Scene Photographer
(B) Primary Evidence Log Custodian
(C) Assigned Field Unit Team Leader
(D) Scene Sketcher (or Draftsman)

39. What is the primary objective of the 'final walkthrough' conducted before releasing a crime scene?
(A) To grant accredited media representatives final supervised access to photograph the processed area

(B) To verify all evidence is collected, gear retrieved, and no areas missed
(C) To assist investigating officers in mentally rehearsing their future witness testimony prior to trial
(D) To officially transfer physical custody of collected material directly to the forensic laboratory director

40. A common failure during crime scene searching is "tunnel vision." In forensic context, this means:
(A) Restricting physical search efforts strictly to dark, unlit spaces while relying solely on tactical flashlights
(B) Methodically searching down a central narrow hallway while completely omitting adjacent rooms from inspection
(C) Focusing on obvious evidence while ignoring subtler trace clues
(D) Operating specialized camera equipment equipped with an inappropriately tight telephoto focal length lens

41. At a suspected arson scene, which of the following is considered an acceptable method of preserving transient explosive or accelerant odours before laboratory analysis?
(A) Packaging the suspected debris in porous paper bags
(B) Leaving the debris in the open air so it dries completely
(C) Washing the debris with distilled water to stabilize the chemicals
(D) Packaging the suspected debris in clean, airtight metal cans

42. When establishing cordons at a major incident scene, where should the command post and staging area for forensic equipment be situated?
(A) Between the intermediate and outer cordons, clear of the focal point
(B) Directly inside the innermost cordon boundary, positioned immediately adjacent to the primary focal point
(C) Beyond the outermost cordon perimeter, co-located within areas accessible to the general public and onlookers
(D) At any arbitrary location across the scene provided it remains clearly visible to assembled media personnel

43. Which of the following physical barriers is least effective for protecting an outdoor crime scene over a period of several days?
(A) High-visibility police barrier tape
(B) A single line of standard cotton rope
(C) Portable metal barricades
(D) A continuous physical chain-link fence

44. To prevent cross-contamination, how should a Scientific Assistant handle different pieces of recovered clothing from a suspect and a victim?
(A) Package them in the same bag to prove they were involved in the same incident
(B) Package each item in separate, clearly labelled, clean paper bags
(C) Package them in airtight plastic bags immediately, regardless of moisture content
(D) Wash them with sterile water before packing them separately

45. Match the specialized search technology in List I with its primary target or application in List II.
List I: (Search Technology)
P. Ground Penetrating Radar (GPR)
Q. Alternate Light Source (ALS)
R. Metal Detector
S. Thermal Imaging Drone
List II: (Target/Application)
1. Detecting latent seminal fluid stains on a bedsheet
2. Locating a discarded iron knife in tall grass
3. Detecting freshly disturbed soil or a clandestine grave
4. Locating a suspect hiding in a forest at night via heat signatures
(A) P-3, Q-1, R-2, S-4
(B) P-1, Q-3, R-4, S-2
(C) P-4, Q-2, R-1, S-3
(D) P-3, Q-4, R-2, S-1

46. During the search of a cybercrime suspect's premises, an officer finds a laptop running with the screen unlocked. What is the correct immediate action to preserve digital evidence?
(A) Instantly disconnect the laptop's power adapter from the electrical socket and forcefully pull out the internal battery
(B) Execute a proper software system power down by navigating through the standard operating system "Shut Down" menu options
(C) Isolate the device, photo the screen, and await a digital expert for live capture
(D) Connect an external storage drive and immediately attempt to manually copy user files before the display locks itself

Click Here to Buy book on Flipkart

47. Which search method would a forensic team most likely use to locate a specific microscopic trace evidence (e.g., a known missing diamond) on a small, textured rug?
(A) Line or strip search across the carpet
(B) Expanding outward spiral search pattern
(C) High-resolution aerial drone search
(D) Micro-grid or detailed zone search

48. When securing a crime scene, dealing with family members of the deceased who wish to enter the inner cordon to grieve poses a significant challenge. The legally and forensically sound response is:
(A) Grant them temporary controlled access to the body in order to prevent severe emotional distress and public outcry
(B) Permit them to cross the perimeter cordons and view the scene provided they wear sterile disposable protective gloves
(C) Deny entry firmly but respectfully to preserve scene integrity
(D) Allow them to enter the inner cordon to grieve only after they have thoroughly washed their hands with disinfectant

49. In the context of a crime scene log, which detail is NOT strictly necessary for the logging officer to record?
(A) The exact time of entry and exit of the individual
(B) The individual's personal home address and bank details
(C) The name and designation of the individual entering
(D) The specific reason or duty requiring their presence in the scene

50. During a systematic search, trace evidence such as a single hair is found on a tile floor. Before picking it up with tweezers, the investigator must first:
(A) Attempt to visually identify the exact biological species origin of the hair fiber
(B) Thoroughly apply fingerprint dusting powder to the entire surrounding tile floor area
(C) Coat the hair strand with a specialized clear aerosol chemical fixative spray to secure it
(D) Photograph the hair in situ with an evidence marker and scale

51. The phenomenon where a crime scene investigator unintentionally leaves their own shoeprints or fingerprints at the scene is known as:
(A) Investigator contamination
(B) Locard's primary contact transfer
(C) Unintentional deliberate evidence tampering
(D) Procedural chain of custody breach

52. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Wet, bloodstained clothing recovered during a search should never be packaged in airtight plastic bags for transport to the forensic laboratory.
Reason (R): Airtight plastic bags retain moisture, promoting bacterial growth and degradation of DNA evidence.
Which of the following is correct?
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(B) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

53. If a firearm is found submerged in a pond during an underwater search, how should it ideally be transported to the forensic laboratory?
(A) Immersed in a container of the original pond water
(B) Thoroughly dried off with cotton towels and placed inside a heavy cardboard firearm shipping box
(C) Generously coated with petroleum-based anti-rust spray and tightly wrapped in protective plastic film
(D) Fully field-stripped and disassembled on site by officers to guarantee the weapon is rendered completely safe

54. When is a 're-search' of a crime scene generally conducted?
(A) Whenever a formally charged criminal suspect or defense counsel submits an official request for re-examination
(B) Exclusively upon receiving a direct legal directive issued by a High Court or Supreme Court bench
(C) Standard operating protocol mandates conducting automatic daily re-searches until court proceedings commence

NODIA

(D) When initial searches occurred under poor conditions and daylight reveals new areas

55. While searching a vehicle involved in a hit-and-run, the forensic expert examines the undercarriage. They are primarily searching for:
(A) Microscopic deposits of unburned gunpowder and chemical gunshot residue (GSR)
(B) Biological tissue, bloodstains, hair strands, or clothing fibres
(C) Fraudulent vehicle ownership documents or forged physical registration papers
(D) High-quality latent friction ridge fingerprints belonging to the motor vehicle driver

56. What standard chemical reagent might be used during a scene search to detect latent, washed-away bloodstains by emitting a blue luminescence?
(A) Ninhydrin
(B) Phenolphthalein
(C) Luminol
(D) Marquis reagent

57. Which type of light wavelength from an Alternate Light Source (ALS) is most commonly used in conjunction with orange goggles to visualize latent semen stains at a crime scene?
(A) Near-infrared spectrum bandwidth (approx. 800-900 nm)
(B) High-energy X-ray radiation band (approx. 0.1-10 nm)
(C) Far-red visible spectrum bandwidth (approx. 650-700 nm)
(D) Ultraviolet and Blue light (approx. 400-450 nm)

58. If an outdoor search requires the use of a grid pattern, how do searchers move to complete the grid?
(A) They traverse parallel paths in one direction, then re-search at a 90-degree angle
(B) They begin at the central focal point and walk outward in expanding concentric circles before reversing directions
(C) They navigate the designated search boundaries in random patterns until the entire terrain has been covered twice
(D) They partition the overall scene into four equal quadrant zones and proceed to search each section diagonally

59. Consider the following statements regarding the protection of a crime scene from weather:
I. Direct, harsh sunlight can degrade DNA evidence on exposed biological stains.
II. Placing an inverted heavy wooden box over a footprint in mud is a valid way to protect it from sudden rain.
III. Strong winds have no significant effect on trace evidence like hair and fibres.
Which of the above statement(s) is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

60. During the search of a deceased person's body at the scene before autopsy, the investigator places clean paper bags over the victim's hands. What is the primary purpose of this action?
(A) To prevent the victim's upper extremities and fingers from prematurely stiffening due to rigor mortis onset
(B) To protect trace material and skin cells under the victim's fingernails
(C) To maintain physical decorum and protect the deceased victim's personal privacy prior to transport
(D) To absorb excess pooling blood or bodily fluids leaking from traumatic injuries on the upper torso

NODIA

61. A scene sketch made during the search phase that incorporates precise measurements using the triangulation method requires measuring the distance of an object from:
(A) Two fixed reference points, such as room corners
(B) A single readily movable reference point, such as a parked motor vehicle
(C) The estimated magnetic North pole aligned with standard compass bearings
(D) The precise geographic center point of the active physical search grid pattern

62. Which of the following defines the 'Baseline Method' of measuring evidence locations during a search?
(A) Estimating physical linear distances across a room by counting the total length of an investigator's footsteps
(B) Measuring angular deviations of physical evidence relative to ceiling structural joints using a protractor
(C) Measuring evidence at right angles to a tape stretched between two fixed points
(D) Utilizing localized high-precision GPS

satellite coordinates exclusively for indoor physical evidence

63. When a forensic field unit completes its search, the physical evidence collected must be sealed. The primary reason for applying a unique seal with a designated impression is to:
(A) Ensure that the physical evidence container presents an official appearance for media broadcasts
(B) Conceal the internal package contents from lower-ranking investigating police officers at the scene
(C) Prevent volatile chemical odours or unpleasant decomposition gas emissions from escaping the box
(D) Protect chain of custody integrity and prevent unauthorized evidence tampering

64. Identify the correct sequence of search pattern selection as the size of the area increases from small to massive:
(A) Aerial drone survey → Point-to-point → Grid search
(B) Strip search → Zone search → Outward spiral
(C) Zone search → Strip search → Aerial drone survey
(D) Grid search → Aerial drone survey → Point-to-point

65. When processing a crime scene, an investigator finds a clear, patent fingerprint pressed into wet paint. This type of evidence is classified as:
(A) Perishable and fleeting transient physical evidence
(B) Plastic (or impression) fingerprint evidence
(C) Invisible latent friction ridge fingerprint evidence
(D) Complex biological trace cellular evidence

66. A major limitation of using highly trained cadaver dogs in hot, dry, and windless conditions is that:
(A) Thermal heat reduces visual acuity, preventing dogs from spotting subtle subterranean burial mounds
(B) High temperatures cause working dogs to frequently misidentify live human bystanders as targets
(C) Low atmospheric humidity causes canines to develop extreme hyper-sensitivity toward metallic objects
(D) Decomposition VOCs do not disperse well, hindering scent detection

67. The documentation of a crime scene search consists of four primary components. Three of them are Notes, Photographs, and Sketches. What is the fourth?
(A) Video recording
(B) The FIR copy
(C) The post-mortem report
(D) The final court verdict

68. Which search technique is highly specialized for detecting deeply buried objects by measuring differences in the magnetic properties of the soil?
(A) Alternate Light Source
(B) Luminol spraying
(C) Proton magnetometer
(D) Ultraviolet reflectography

69. Consider the following actions taken during a crime scene search:
I. Eating and drinking inside the intermediate cordon
II. Using the suspect's bathroom in the secured premises
III. Adjusting the air conditioning in the room to cool the officers
IV. Wearing latex gloves while handling evidence
Which of the above actions represent incorrect or unprofessional practices?
(A) I, II, and IV
(B) I, II, and III
(C) II, III, and IV
(D) I, III, and IV

70. When a first responder arrives at a scene involving a suspected explosive device, the most critical step in securing the scene is:
(A) Manually lifting and transporting the unexploded device to an open area away from structures
(B) Placing a heavy containment blanket or bulletproof vest directly over the suspicious package
(C) Approaching closely to take detailed macro photographs of electrical wiring before notifying specialists
(D) Evacuating the area to a safe distance and setting a wide perimeter

71. Why must crime scene investigators change their gloves frequently during a search, especially when moving between different rooms or handling different items?

Downloaded from www.pdf.tube

(A) Disposable latex and nitrile protective gloves degrade and dissolve rapidly when exposed to ambient room air
(B) To prevent cross-contamination of trace evidence or DNA between items
(C) To prevent excessive perspiration build-up on the investigator's hands during extended scene processing
(D) Because departmental administrative regulations strictly mandate consuming a specific numerical quota of gloves

72. Which search method is generally best suited for a team of 10 searchers looking for a discarded murder weapon in a vast, flat, grassy field?
(A) Outward spiral
(B) Zone search
(C) Strip or line search
(D) Point-to-point search

73. If a mobile phone is discovered during a search, which of the following is an unacceptable method of handling it?
(A) Enclosing the seized mobile device inside a specialized Faraday bag to block incoming remote wiping commands
(B) Maintaining the active power state if discovered powered on, while taking proper steps to isolate network connections
(C) Capturing high-resolution photographs of the active display screen prior to physically touching the device
(D) Attempting to guess the user passcode repeatedly to view messages

74. The process of marking, labelling, sealing, and securely storing evidence, along with keeping a continuous documented record of every person who handled it, is known as:
(A) Chain of Custody
(B) Locard's Exchange
(C) Standard Operating Procedure
(D) The Bertillon System

75. Arrange the following actions taken upon finding a suspected bloodstain during a room search in the correct order:
I. Swab or collect the stain
II. Visually identify the stain
III. Place an evidence marker and scale next to the stain
IV. Photograph the stain in its context and close-up
Select the correct order:
(A) II, IV, III, I
(B) II, III, IV, I
(C) III, II, IV, I
(D) I, II, III, IV

76. During an indoor search, if a window is found broken from the outside, the investigator must carefully protect the glass shards primarily to analyze:
(A) The specific chemical gas composition and particulate matter present in the surrounding outdoor air
(B) Radial and concentric fracture patterns to find impact direction and sequence
(C) The presence of etched commercial trade logos or manufacturer serial barcodes on glass fragments
(D) The localized thermal heat resistance rating and melting point properties of the window pane

NODIA

77. To effectively search for latent footprints on a dusty tile floor, an investigator should ideally use:
(A) Oblique side-angle lighting to cast distinct shadows in dust prints
(B) High-intensity direct overhead floodlighting positioned perpendicular to the floor surface
(C) Handheld thermal infrared imaging cameras operated at maximum sensitivity settings
(D) Standard pulse-induction electromagnetic metal detection equipment held near the floor

78. A 'zone' or 'quadrant' search of a vehicle might logically divide the vehicle into:
(A) Dividing the vehicle exclusively into two broad halves consisting of the left side and right side
(B) Categorizing search sectors strictly based on exterior rubber tyres versus glass window panes
(C) Front cabin, rear seating, trunk space, and engine compartment sectors
(D) Classifying vehicle inspection zones according to metallic bodywork versus plastic interior components

79. When conducting a search of an outdoor scene, what is the best practice for investigators regarding their approach path to the focal point?
(A) Walk strictly along the precise trajectory that the suspect is logically inferred to have utilized during the crime

(B) Approach the central scene directly from the highest elevated geographical point in the surrounding terrain
(C) Drive an emergency police response vehicle as near to the primary focal point as physically possible
(D) Use a designated safe path distinct from the suspect's probable route

80. Match the common search failure in List I with its description in List II.
List I: (Search Failure)
P. Tunnel Vision
Q. Premature assumption
R. Cross-contamination
S. Inadequate perimeter
List II: (Description)
1. Allowing the media to stand too close, destroying footprint evidence
2. Using the same tweezers to collect two different bloodstains without cleaning
3. Focusing only on a visible bloody knife and ignoring a latent shoe print
4. Deciding it is a suicide based on a hanging body and stopping the search for struggle signs
(A) P-4, Q-3, R-1, S-2
(B) P-1, Q-2, R-3, S-4
(C) P-3, Q-4, R-2, S-1
(D) P-3, Q-2, R-4, S-1

81. Which chemical is frequently used by forensic teams to develop latent fingerprints on porous surfaces (like a ransom note paper) found during a scene search?
(A) Cyanoacrylate (Superglue)
(B) Ninhydrin
(C) Sudan Black
(D) Amido Black

82. Which of the following is a critical safety consideration when searching a clandestine drug laboratory scene?
(A) Wearing heavy acoustic noise-cancelling tactical headphones during scene inspection
(B) Activating all internal electrical switches and lighting fixtures to achieve maximum visibility
(C) Directly tasting small samples of unknown seized powders to rapidly identify illicit narcotics
(D) Wearing a self-contained breathing apparatus due to toxic chemical fumes

83. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): The strip search method is generally preferred over the grid method when a very large rural area must be covered quickly by a team.
Reason (R): The strip method requires searchers to traverse the area only once, saving time compared to the double-pass of a grid search.
Which of the following is correct?
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(B) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

84. An inquest report (Panchnama) detailing the position of the body and visible injuries at a crime scene is typically prepared under which legal provision?
(A) Section 302 of the Indian Penal Code (or equivalent BNS provision)
(B) Section 45 of the Indian Evidence Act (or equivalent BSA provision)
(C) Section 174 CrPC / Section 194 BNSS
(D) Section 25 of the Arms Act (or equivalent statutory provision)

85. Consider the following statements regarding the protection of a crime scene:
I. Once an item is removed from the scene, it can be placed back exactly where it was to take a photograph.
II. A crime scene sketch provides spatial relationships that a photograph cannot capture perfectly.
III. The outer perimeter should ideally be much larger than the suspected area of criminal activity.
Which of the above statement(s) is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

86. Which type of search is conceptually divided into macro-scenes (e.g., the entire house) and micro-scenes (e.g., a specific bloodstained rug in the bedroom)?
(A) Spiral search

Click Here to Buy book on Amazon

STUDYING FROM PDFs?

THINK AGAIN.

If you are studying only from PDFs,
you are wasting valuable time.

Research shows that learning from

PRINTED BOOKS has up to

4× HIGHER RETENTION

than studying from screens.

PRINT BOOK = BETTER MEMORY

PDF = LOWER RETENTION

Those who study from **PRINTED BOOKS**
move **AHEAD.**

Others are left **BEHIND**
in competition.

In competitive exams,
being average is not enough.

STAY ONE STEP AHEAD.

(B) Point-to-point search
(C) Ray search
(D) Zone search

87. Match the step of securing a scene in List I with its primary rationale in List II.
List I: (Step of Securing a Scene)
P. Removing unauthorized personnel
Q. Taping off the perimeter
R. Creating a designated pathway
S. Establishing a command post
List II: (Primary Rationale)
1. To provide a clear visual boundary for the public
2. To prevent destruction or theft of evidence
3. To coordinate search efforts and store equipment safely
4. To minimize the introduction of new footwear impressions
(A) P-1, Q-2, R-3, S-4
(B) P-2, Q-1, R-4, S-3
(C) P-4, Q-3, R-2, S-1
(D) P-2, Q-4, R-1, S-3

88. Consider the following statements regarding a properly executed crime scene log:
I. It must be maintained continuously until the scene is officially released.
II. It should note the specific agency or department of the entering personnel.
III. It must contain the signatures of all media personnel waiting outside.
IV. It helps defend against legal claims of scene contamination in court.
Which of the above statement(s) is/are correct?
(A) I, II, and III
(B) I, II, and IV
(C) II, III, and IV
(D) I, III, and IV

89. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): During an indoor crime scene search, investigators should always wear disposable shoe covers (booties).
Reason (R): Booties prevent the investigator's footwear from depositing foreign soil, dust, or DNA while simultaneously protecting their own shoes from biohazards.
Which of the following is correct?
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(B) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

NODIA

90. Consider the following activities during the 'final walkthrough' phase:
I. Ensuring all evidence markers are collected and no equipment is left behind.
II. Verifying that all planned searches and documentation steps have been completed.
III. Conducting an initial interview with the prime suspect on the premises.
Which of the above statement(s) represents valid objectives of the final walkthrough?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

www.nodia.in

ANSWERS

1. (B) To preserve life and secure the area from unauthorized access
The primary duty of the first officer arriving at a crime scene is ensuring personal safety, providing emergency medical assistance to injured victims, and securing the physical area to prevent unauthorized access. Preserving life takes precedence over all other operational tasks, followed immediately by establishing perimeters to protect fragile evidence from loss, contamination, or alteration.

2. (D) By encompassing the focal point, all suspected entry/exit paths, and secondary scenes
Determining outer perimeters requires incorporating the immediate focal location where criminal activity occurred, potential ingress and egress routes used by perpetrators or victims, and any related secondary locations. Setting expansive boundaries during initial isolation prevents crucial trace physical evidence along transit routes from being disturbed or destroyed before trained forensic personnel arrive for systematic processing.

3. (A) To minimize the risk of contamination and destruction of evidence by personnel
Establishing a single, strictly monitored entry and exit point ensures controlled access for responding operational personnel. Restricting movement to a designated common pathway prevents investigators and emergency responders from traversing multiple unexamined areas, thereby significantly minimizing cross-contamination risks, preserving latent physical footprints or biological traces, and maintaining strict scene integrity throughout investigation activities.

4. (C) Only designated crime scene investigators and essential forensic experts
In a standard three-tier perimeter system, the inner cordon defines the critical zone surrounding actual physical evidence where actual crime scene processing occurs. Access to this innermost zone is strictly restricted to active crime scene investigators, forensic specialists, and designated evidence collection technicians actively performing mandatory forensic duties to protect delicate biological material and physical items from disturbance.

5. (A) Brightly coloured police barrier tape
Brightly coloured barrier tape marked with warning text provides a rapid, highly visible, and portable physical boundary for temporary scene isolation. First responders utilize high-contrast tape across trees, posts, or vehicles to instantly establish visual inner and outer perimeters, effectively warning unauthorized members of the public and non-essential personnel against entering restricted operational zones.

6. (D) The transfer of trace material from one distinct item of evidence to another
Cross-contamination occurs when microscopic biological materials, hair fibres, soil particles, or chemical residues are inadvertently transferred between separate items of physical evidence or between investigative personnel and evidence. Preventing cross-contamination requires using sterile tools, replacing disposable protective gloves between handling different exhibits, and packaging collected physical evidence items into separate, securely sealed containers.

7. (B) P-3, Q-4, R-1, S-2
The inner cordon isolates the immediate area containing primary physical evidence, restricting access to forensic specialists. The intermediate cordon functions as a staging zone for command structures, technical equipment, and operational briefing. The outer cordon creates the public barrier excluding media and spectators, while the scene log checkpoint monitors all authorized personnel moving past boundaries.

8. (C) Shedding natural hair or respiratory droplets directly onto evidence
Operational personnel conducting scene examinations represent primary contamination vectors through bodily shedding. Unintentional deposit of epithelial cells, saliva droplets from speech, coughing, or sneezing, and natural head hair directly onto uncovered evidence introduces foreign biological material. Wearing protective masks, caps, and full suit barriers eliminates

Downloaded from www.pdf.tube

investigator DNA and hair contamination during close-range physical processing.

9. (D) To prevent the investigator's own DNA and fibres from mixing with scene evidence
Forensic personnel wear comprehensive protective outerwear including fluid-resistant Tyvek suits, disposable gloves, face masks, and shoe coverings to prevent introducing their personal hair, skin squames, respiratory droplets, or clothing fibers into the environment. This rigorous barrier practice prevents potential contamination of delicate biological samples and trace evidence, preserving authentic forensic profiles for legal analysis.

10. (A) The smell of unburnt petrol in an arson case
Transient evidence refers to physical indicators that are perishable, volatile, or temporary by nature, disappearing rapidly due to environmental dissipation or time passage. Atmospheric odours, volatile hydrocarbon fumes from liquid accelerants, surface temperatures, and fleeting outdoor imprints represent transient evidence requiring immediate olfactory or instrumental documentation before chemical evaporation renders them completely unmeasurable at scenes.

11. (B) Erect a waterproof pop-up tent or umbrella structure over it that preserves surrounding air circulation
Sudden precipitation threatens to wash away water-soluble biological stains, soil traces, and impression evidence. Erecting overhead canopy structures or open tents shields exposed evidence from rainfall while maintaining natural ambient airflow around items. Placing non-porous plastic tarpaulins directly onto wet evidence is avoided because trapping moisture accelerates rapid bacterial growth and biological decay.

12. (B) Secure and guard the scene until daylight allows for a comprehensive search
Conducting nighttime physical searches under insufficient illumination increases the probability of overlooking crucial microscopic trace evidence, contaminating delicate impression features, or trampling unperceived items. Standard protocol dictates securing perimeter boundaries with continuous physical sentries until natural morning light or heavy artificial mobile lighting rigs enable a thorough, reliable, and comprehensive scene examination.

13. (A) To record the identity, time, and purpose of all personnel entering the area
A crime scene entry log provides a legally enforceable chronologically documented record detailing every individual entering or leaving isolated boundaries. Documenting precise entry times, exit times, agency affiliations, and specific operational purposes creates total accountability, helps identify potential investigators who might have deposited foreign trace material, and defends the evidentiary chain of custody in court.

14. (C) I and III only
Preserving human life always supersedes physical evidence preservation during emergency response operations. Emergency medical technicians must enter immediately to evaluate and treat surviving victims. Responders should minimize disturbance to physical items, and investigators must carefully record the entry pathways and precise movements of medical personnel to account for any unavoidable alteration of physical evidence.

NODIA

15. (D) Locard's Exchange Principle
Locard's Exchange Principle asserts that whenever two objects or individuals come into contact, a mutual transfer of physical material occurs. Unauthorized individuals crossing scene perimeters inadvertently leave behind foreign clothing fibres, footwear impressions, or biological cells while simultaneously carrying away microscopic trace evidence from the location, thereby compromising the scientific validity of subsequent forensic evidence.

16. (C) To locate, identify, and document all physical evidence relevant to the crime
The ultimate purpose of a systematic search pattern is locating, recognizing, documenting, and recovering all relevant physical, biological, and digital evidence present within isolated boundaries. Conducting structured visual sweeps ensures complete coverage of spatial areas, preventing overlooked trace materials and enabling objective reconstruction of criminal events through rigorous scientific evaluation of physical evidence.

17. (B) Strip or line search
A strip or line search method is optimal for searching large, open outdoor spaces like fields or pastures. Search personnel form a straight parallel line spaced at equal distances, advancing

slowly in unison across designated terrain. This systematic linear approach ensures uniform visual coverage, preventing unsearched gaps while thoroughly inspecting expansive ground surfaces for physical items.

18. (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
Grid search methodology provides thorough coverage by requiring searchers to traverse a designated space completely in one direction along parallel lanes, then repeat the entire process perpendicularly at ninety degrees. This double-pass coverage maximizes the probability of uncovering minute, obscured, or hidden trace evidence, making it highly reliable yet significantly time-consuming compared to single-pass methods.

19. (A) At the outer perimeter of the search area and spirals inward toward the centre
An inward spiral search pattern commences along the established outer boundary line of a crime scene. Searchers walk along a continuously decreasing circular or spiral trajectory, gradually working inward toward the central focal area. This approach is effective when outer boundaries are clearly defined and allows initial inspection before stepping directly near central evidence.

20. (C) Zone or quadrant method
The zone or quadrant search method systematically divides complex or multi-room environments into smaller, clearly demarcated structural sectors or individual rooms. Assigned investigators perform dedicated searches within each specific zone using appropriate secondary search patterns. This structured approach prevents confusion, ensures complete room-by-room processing, and manages search efforts effectively across expansive indoor locations or motor vehicles.

21. (A) Evidence radiates from a central focal point, such as an explosion
Outward spiral search patterns originate at the central focal point of an incident and systematically expand in growing concentric circular sweeps toward outer boundaries. This pattern is particularly suitable for explosion sites or localized discharge points where debris, shrapnel, or physical evidence radiates outwards in all directions from a single identifiable epicenter.

22. (D) Gaps between search paths expand as searchers move outward, creating unsearched spaces
The wheel or radial search pattern involves personnel starting near a central point and walking outward along straight ray pathways. As searchers move further away from the center, the linear distance between adjacent radiating lines progressively increases, creating large uninspected wedge-shaped gaps that increase the likelihood of missing small physical evidence items.

23. (B) It overlooks areas between visible items where latent evidence may exist
Point-to-point searching relies on moving directly between obvious, visible items of evidence. This unsystematic approach is disfavoured because searchers focus exclusively on prominent objects, completely failing to conduct structured sweeps of intermediate ground surfaces where non-obvious latent evidence, microscopic trace materials, blood drops, or footwear impressions may remain unnoticed.

24. (C) The floor, walls, and ceiling to locate blood spatter and projectiles
Comprehensive indoor searching requires inspecting three-dimensional space completely rather than focusing solely on floor levels. High-velocity impacts, violent struggles, or firearm discharges propel blood drops, bullet fragments, wall impacts, or high friction contact marks onto surrounding walls and overhead ceilings. A thorough vertical and horizontal search ensures complete recovery of physical evidence.

25. (D) They must maintain a straight line, equal spacing, and a uniform pace
Maintaining line alignment, constant equal spacing between personnel, and a uniform walking speed is critical during line searches through dense terrain. Uncoordinated movement or varying speeds create uneven coverage gaps where physical evidence can easily remain undetected under heavy foliage. Continuous line discipline ensures systematic visual inspection across the entire search area.

Click Here to Buy book on Flipkart

26. (A) Search the exterior → Search the undercarriage → Search the interior cabin → Search the trunk
Systematic vehicle processing prioritizes external surface examination before entering enclosed spaces. Examining exterior panels and the undercarriage first recovers fragile exterior trace evidence like fibers, paint transfer, blood, tissue, or mud without disturbance. Searching interior passenger compartments and enclosed trunk spaces afterwards ensures a logical progression from outer surfaces to protected internal sections.

27. (B) Section 50 of the Bharatiya Nagarik Suraksha Sanhita (BNSS)
Section 50 of the Bharatiya Nagarik Suraksha Sanhita provides explicit statutory authority empowering arresting officers to conduct searches of an arrested person's physical body. This legal provision enables lawful seizure of articles, weapons, trace evidence, or personal property found on the suspect, ensuring physical evidence is secured while maintaining compliance with procedural legislation.

28. (B) Arc sweep search using a tether line anchored to a central weight
Underwater recovery searches in low visibility utilize structured tethered sweep patterns. A weighted anchor placed on the riverbed or seabed serves as a central point for a diver holding a measured line. Moving back and forth along expanding semicircular arcs maintains physical orientation, ensuring systematic tactile coverage of submerged aquatic bed surfaces.

29. (A) Digging directly into the grave using heavy backhoes
Heavy machinery like backhoes causes catastrophic destruction to buried skeletal remains, crushing fragile bones, disrupting contextual soil stratigraphy, and obliterating microscopic tool marks. Archaeological forensic excavation protocols mandate manual soil removal using small trowels and brushes in thin, uniform horizontal layers, accompanied by screening all excavated soil through fine mesh sieves.

30. (C) Anomalies in electromagnetic fields caused by conductive metallic objects
Metal detectors operate by generating a primary electromagnetic field from a search coil into the ground. Metallic objects entering this field experience induced eddy currents, which generate a secondary magnetic field. The detector senses this electromagnetic anomaly, producing audible signals that alert operators to concealed metallic items such as weapons or cartridge cases.

31. (C) I, III, and IV
Ground Penetrating Radar emits high-frequency radio pulses into the ground and measures reflected electromagnetic signals to map subsurface anomalies without physically disturbing topsoil. It effectively locates clandestine graves and buried items non-destructively, though signal penetration depth can be significantly attenuated in soils with high moisture content or clay density.

32. (C) Volatile organic compounds specific to human decomposition
Human Remains Detection dogs, commonly termed cadaver dogs, are specifically trained to detect gaseous volatile organic compounds emitted during human biological decomposition. Their olfactory sensitivity allows them to differentiate between decaying animal tissue and human decomposition products, pinpointing buried human remains, concealed bodies, or residual decomposition fluids in diverse outdoor environments.

33. (B) Absorption and fluorescence of biological fluids at specific light wavelengths
Alternate Light Sources project specific narrow light wavelengths onto target surfaces. Biological fluids such as semen, saliva, and urine absorb these specific light frequencies and re-emit light energy at longer visible wavelengths through photoluminescence. Viewing these surfaces through complementary barrier filter goggles highlights latent stains that remain invisible under standard white light illumination.

34. (D) They provide high-resolution aerial photogrammetry for accurate 3D mapping
Unmanned aerial vehicles equipped with cameras enable rapid high-resolution aerial photogrammetry over expansive disaster zones or large outdoor scenes. Aerial imagery allows software to generate precise three-dimensional terrain models, map spatial relationships between dispersed physical evidence, and capture comprehensive site overviews without risking footprint disturbance or evidence trampling by ground search personnel.

Downloaded from www.pdf.tube

35. (A) A Magistrate having proper jurisdiction
Under the provisions of the Bharatiya Nagarik Suraksha Sanhita, a judicial search warrant authorizing police to enter and inspect private premises is legally issued by a Magistrate holding territorial jurisdiction. Judicial authorization balances fundamental privacy rights with investigative mandates, ensuring search actions comply strictly with statutory due process and evidentiary admissibility standards.

36. (C) II, I, III, IV
Processing a crime scene follows a mandatory chronological progression. Initial responders secure and isolate the physical area to preserve scene integrity. Next, investigators conduct a systematic physical search to discover evidence locations. Found items are thoroughly documented through photographs and sketches in place before evidence collection, packaging, and sealing operations commence.

37. (A) To show evidence locations in photos and sketches prior to collection
Numbered or lettered plastic evidence markers placed beside discovered physical items provide clear visual identifiers. These markers establish spatial context, relative positioning, and item indexing during photographic documentation and preliminary sketching. Marking items in situ before collection ensures accurate representation of evidence locations for subsequent court room presentations and scene reconstruction.

38. (D) Scene Sketcher (or Draftsman)
The dedicated scene sketcher or draftsman is responsible for recording precise physical measurements and spatial relationships of evidence relative to fixed reference points. Producing accurate rough field sketches with triangulation or baseline measurements ensures exact physical dimensions are preserved, complementing photographic records and enabling spatial reconstruction of the scene layout.

39. (B) To verify all evidence is collected, gear retrieved, and no areas missed
Conducting a final walkthrough before officially releasing a crime scene serves as a quality assurance review. Investigators inspect all sectors to confirm every marked physical evidence item has been collected, verify operational equipment has been retrieved, check that no hazardous material remains, and ensure all investigative steps were thoroughly executed.

NODIA

40. (C) Focusing on obvious evidence while ignoring subtler trace clues
Tunnel vision occurs when investigators focus exclusively on prominent physical objects, such as visible weapons, while ignoring surrounding contextual elements or subtle trace clues. Prematurely fixating on single items leads to overlooking latent fingerprints, hair fibres, footwear marks, or alternative investigative theories, ultimately compromising the thoroughness and objectivity of crime scene processing.

41. (D) Packaging the suspected debris in clean, airtight metal cans
Fire debris containing volatile accelerants must be packaged immediately inside clean, unlined, airtight metal cans or specialized vapor-impermeable bags. Non-porous sealed containers trap evaporating chemical vapors, preventing hydrocarbon loss to ambient air and allowing forensic laboratory instruments to analyze trapped head-space gases for identifying liquid accelerant residues.

42. (A) Between the intermediate and outer cordons, clear of the focal point
Operational command posts, equipment staging zones, and briefing areas must be established in the neutral zone located between the intermediate and outer perimeters. This placement maintains safe proximity to ongoing operations while keeping heavy foot traffic, vehicles, and technical equipment completely outside the inner cordon where primary evidence preservation takes place.

43. (B) A single line of standard cotton rope
A single line of plain cotton rope provides minimal physical barrier protection across extended outdoor multi-day operations. Plain rope lacks high-visibility warning markings, sags over time, and is easily crossed by unauthorized individuals. Effective multi-day perimeters require high-contrast barrier tape, heavy metal barricades, or continuous chain-link fencing to maintain security boundaries.

44. (B) Package each item in separate, clearly labelled, clean paper bags
Cross-contamination prevention requires packaging victim and suspect garments

separately into distinct, clean, breathable paper bags. Breathable paper prevents moisture buildup that causes biological degradation, while isolated packaging prevents cross-transfer of fibers, hair, or DNA between opposing parties, preserving the evidentiary integrity of each collected clothing item for scientific testing.

45. (A) P-3, Q-1, R-2, S-4
Ground Penetrating Radar identifies soil disturbances indicative of clandestine graves. Alternate Light Sources induce fluorescence to reveal latent biological fluids like seminal stains. Metal detectors locate metallic objects such as weapons hidden in grass. Thermal imaging drones detect heat signatures emitted by individuals concealed in dark or forested surroundings.

46. (C) Isolate the device, photo the screen, and await a digital expert for live capture
Finding an unlocked, running computer requires immediate action to preserve volatile RAM data. Investigators must capture screen photographs, physically isolate network connectivity to prevent remote wiping, avoid navigating menus, and immediately consult digital forensic experts to perform live memory dumps before powering down or locking the running operating system.

47. (D) Micro-grid or detailed zone search
Locating minute, microscopic evidence on textured surfaces like rugs requires a micro-grid or fine zone search method. Dividing the rug into small, defined sub-sections allows investigators to conduct close-range visual sweeps using magnification and focused oblique lighting, ensuring thorough inspection of carpet fibers without missing small items.

48. (C) Deny entry firmly but respectfully to preserve scene integrity
Protecting crime scene perimeters requires denying entry to unauthorized individuals, including grieving family members. Uncontrolled access leads to evidence contamination, trampling of footwear impressions, and loss of delicate biological traces. Officers must handle relatives with compassion and empathy while maintaining strict physical boundaries to preserve total forensic integrity.

49. (B) The individual's personal home address and bank details
Crime scene entry logs focus strictly on operational security and accountability. Required details include full name, rank or designation, agency affiliation, exact entry and exit times, and specific duty purpose. Personal sensitive data like home addresses or bank information are irrelevant to log requirements and are omitted from official entry records.

50. (D) Photograph the hair in situ with an evidence marker and scale
Standard forensic protocol dictates documenting physical evidence in place before recovery. Finding a hair strand requires placing an evidence marker and scale alongside, followed by taking close-up photographs to establish contextual location. Photographing items in situ verifies physical context and protects against claims of evidence planting or mishandling.

51. (A) Investigator contamination
Investigator contamination occurs when personnel inadvertently introduce their own physical traces into a scene. Accidental deposition of footwear impressions, latent friction ridge prints, hair, or skin squames alters the physical environment. Using proper personal protective clothing, disposable shoe covers, and clean gloves minimizes investigator contamination during evidence processing.

52. (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
Moisture trapped inside non-porous plastic bags creates a humid environment that accelerates bacterial, fungal, and enzymatic breakdown of biological materials. Wet bloodstained garments must be air-dried in controlled environments before packaging in porous paper bags, ensuring DNA integrity is protected from rapid microbial decay during transport to forensic laboratories.

53. (A) Immersed in a container of the original pond water
Submerged firearms recovered from water bodies should be transported fully immersed in a container filled with water from the recovery site. Air exposure initiates rapid oxidation and rusting on metallic components, destroying delicate metal surfaces, rifling marks, and latent

Click Here to Buy book on Amazon

trace evidence before laboratory technicians perform controlled cleaning and analysis.

54. (D) When initial searches occurred under poor conditions and daylight reveals new areas
Re-searching a crime scene becomes necessary when initial processing occurred under adverse environmental conditions, such as poor illumination, severe weather, or chaotic emergency conditions. Returning during bright daylight allows forensic teams to re-examine spatial boundaries, uncover previously obscured physical evidence, and ensure comprehensive search completion.

55. (B) Biological tissue, bloodstains, hair strands, or clothing fibres
Undercarriage inspections in hit-and-run vehicle investigations focus on locating transferred biological evidence resulting from physical impact. Physical contact between a vehicle chassis and a victim often deposits tissue fragments, bloodstains, hair, or synthetic clothing fibers onto low-hanging mechanical components, providing vital associative link evidence linking vehicles to hit-and-run victims.

56. (C) Luminol
Luminol is a chemiluminescent chemical reagent widely used to detect latent or thoroughly washed bloodstains. When sprayed onto suspect surfaces in darkened conditions, luminol reacts with iron catalytic centers present in hemoglobin, producing an intense blue luminescence that highlights hidden blood trace patterns not visible under standard daylight or ambient lighting.

57. (D) Ultraviolet and Blue light (approx. 400-450 nm)
Seminal fluid fluoresces naturally when exposed to excitation wavelengths within the ultraviolet and blue light spectrum, around four hundred to four hundred fifty nanometers. Utilizing an Alternate Light Source in combination with orange barrier filter goggles blocks reflected excitation light while transmitting fluorescent emission wavelengths, making latent semen stains visible.

58. (A) They traverse parallel paths in one direction, then re-search at a 90-degree angle
Grid search execution requires personnel to traverse the designated search area along parallel linear lanes in one direction. Upon completing the initial sweep, searchers turn ninety degrees and repeat the process across perpendicular lanes. This double-pass coverage ensures complete overlap, minimizing missed areas and thoroughly uncovering concealed physical evidence.

59. (A) I and II only
Direct ultraviolet sunlight causes photochemical degradation of DNA molecules present in biological stains, degrading sample quality. Placing an inverted rigid wooden box over fragile mud impressions protects them from sudden rainfall without contacting delicate surface features. Strong winds significantly affect light trace evidence like loose hairs and light fibers by dispersing them.

60. (B) To protect trace material and skin cells under the victim's fingernails
Placing clean paper bags over a victim's hands before body transport protects fragile trace evidence located on fingers and under fingernails. Physical struggles often trap suspect skin cells, blood, hair, or textile fibers beneath nails, and paper wrapping prevents loss or foreign contamination during transport to the autopsy facility.

61. (A) Two fixed reference points, such as room corners
Triangulation mapping requires measuring precise linear distances from an item of evidence to two permanent, immovable reference points, such as structural room corners or fixed doorframes. Forming a geometric triangle between the two fixed points and the object establishes exact spatial coordinates, allowing accurate recreation of evidence positioning in scale drawings.

NODIA

62. (C) Measuring evidence at right angles to a tape stretched between two fixed points
The baseline measurement method utilizes a straight measuring tape stretched taut between two permanent reference points within a scene. Investigators measure distance along this central baseline to a point perpendicular to the evidence item, then measure the right-angle distance from the baseline to the item, establishing precise two-dimensional positioning coordinates.

63. (D) Protect chain of custody integrity and prevent unauthorized evidence tampering
Applying tamper-evident seals bearing unique officer signatures or official impressions onto

evidence containers guarantees physical security and authenticity. Official seals ensure that any unauthorized opening, tampering, or content alteration during transit or storage remains immediately detectable, safeguarding chain of custody integrity for legal scrutiny in judicial proceedings.

64. (C) Zone search → Strip search → Aerial drone survey
Selecting search patterns depends on total spatial area dimensions. Small enclosed areas utilize zone search techniques for targeted sectioning. Intermediate open fields benefit from parallel line or strip search methods. Massive geographic regions or disaster zones require aerial drone surveys to efficiently cover expansive terrain from above.

65. (B) Plastic (or impression) fingerprint evidence
Plastic fingerprints are three-dimensional impression prints formed when friction ridge structures press into soft, pliable media such as wet paint, fresh putty, wax, or soap. Unlike two-dimensional flat prints, plastic impressions retain depth contours of ridge patterns, providing clear three-dimensional detail without requiring chemical reagent development prior to photography.

66. (D) Decomposition VOCs do not disperse well, hindering scent detection
Hot, dry, and stagnant air conditions impair canine search performance during human remains detection. Extreme heat causes dogs to pant heavily to regulate body temperature, reducing olfactory efficiency. Lack of air movement prevents volatile decomposition compounds from dispersing into detectable scent plumes, hindering cadaver dogs from tracking target odours.

67. (A) Video recording
Complete crime scene documentation relies on four complementary methods: detailed written notes, comprehensive photographic records, accurate scale sketches, and continuous video recording. Video recording provides dynamic spatial context, visual relationships, and real-time audio commentary, capturing comprehensive environmental perspectives that static photographs and written notes alone cannot fully represent.

68. (C) Proton magnetometer
A proton magnetometer measures localized variations in the Earth's magnetic field caused by buried ferrous metal objects or disturbed soil structures. Detecting magnetic anomalies enables forensic teams to discover deeply buried weapons, iron containers, or clandestine graves without causing physical destruction to topsoil layers across expansive outdoor search locations.

69. (B) I, II, and III
Consuming food or drink inside cordoned boundaries introduces foreign biological matter and trash. Using bathroom facilities in secured premises destroys latent water or surface evidence while introducing investigator traces. Adjusting air conditioning alters ambient temperatures and air currents, impacting volatile evidence drying rates. Wearing latex gloves remains correct protective practice.

70. (D) Evacuating the area to a safe distance and setting a wide perimeter
Discovering suspected explosive devices requires immediate evacuation of all personnel to safe stand-off distances and establishing expansive security perimeters. Unqualified responders must never handle, move, cover, or photograph suspicious devices closely, as anti-handling mechanisms or wireless triggers could cause catastrophic detonation before explosive ordnance disposal teams arrive.

71. (B) To prevent cross-contamination of trace evidence or DNA between items
Changing disposable gloves frequently when moving between different rooms or handling distinct evidence items prevents cross-transfer of biological materials, DNA, or trace particles. Utilizing the same gloves repeatedly transfers microscopic residue from one exhibit to another, creating false associative links and compromising scientific validity during forensic analysis.

72. (C) Strip or line search
A strip or line search method is optimal for deploying multi-person teams across large, flat outdoor environments. Searchers line up at equal shoulder-to-shoulder distances and advance slowly across the terrain in parallel tracks. This organized team formation ensures continuous visual inspection, preventing overlooked gaps while efficiently searching for weapons.

Downloaded from www.pdf.tube

73. (D) Attempting to guess the user passcode repeatedly to view messages
Attempting repeated manual passcode guesses on seized mobile devices is improper practice. Multiple failed attempts can trigger automated security protocols, permanently locking or wiping internal device storage. Correct procedures require isolating radio signals using Faraday shielding, photographing active display screens, and utilizing specialized digital extraction tools in laboratory settings.

74. (A) Chain of Custody
The chain of custody represents the continuous, unbroken, written log tracking physical evidence from initial collection to court presentation. Documenting every individual who took custody, transfer dates, times, and operational reasons proves evidence authenticity, establishing that items analyzed in court remain identical and untampered with since recovery from the scene.

75. (B) II, III, IV, I
Processing suspect bloodstains follows strict sequential steps. Investigators first visually identify the stain, then place a numbered marker and scale adjacent to establish spatial reference. Next, comprehensive context and close-up photographs are taken to document original appearance before finally performing physical swabbing or sample collection for laboratory testing.

76. (B) Radial and concentric fracture patterns to find impact direction and sequence
Recovering glass fragments from point-of-entry windows enables laboratory evaluation of fracture dynamics. Examining radial fractures, concentric cracks, and stress lines (Hertzian cones) reveals the physical direction of impact force and determines whether the pane was broken from outside or inside, while assisting in establishing fracture sequence order.

77. (A) Oblique side-angle lighting to cast distinct shadows in dust prints
Oblique side-angle illumination directs light beams at low angles across smooth surfaces, casting pronounced shadows along raised or indented dust impression features. Directing light horizontally increases visual contrast between dusty footprint ridge patterns and smooth floor tiles, making latent dust footprints clearly visible for photography and recovery.

78. (C) Front cabin, rear seating, trunk space, and engine compartment sectors
Applying zone search methodology to motor vehicles requires partitioning the physical structure into distinct, manageable operational sectors. Standard vehicle zones comprise the front cabin area, rear passenger seating, enclosed trunk compartment, and front engine bay. Dedicated searches within each individual zone ensure complete, systematic evidence coverage.

79. (D) Use a designated safe path distinct from the suspect's probable route
Approaching an outdoor crime scene requires establishing a designated access pathway distinct from ingress or egress routes likely used by perpetrators. Utilizing alternative entry paths prevents investigating officers from trampling suspect footwear impressions, destroying tire tracks, or depositing foreign footwear soil traces along routes containing key physical evidence.

80. (C) P-3, Q-4, R-2, S-1
Tunnel vision involves fixating on obvious evidence while ignoring surrounding trace clues. Premature assumption means prematurely concluding cause without searching for struggle indicators. Cross-contamination occurs from reusing tools across different evidence items without cleaning. Inadequate perimeter setup permits spectators to step close, destroying delicate outer footprint evidence.

81. (B) Ninhydrin
Ninhydrin is a chemical reagent widely utilized to develop latent fingerprints on porous substrates such as paper, cardboard, or wood. Ninhydrin reacts with amino acids present in eccrine sweat secretions deposited by friction ridges, forming a distinct purple-pink compound known as Ruhemann's purple, revealing clear ridge detail.

82. (D) Wearing a self-contained breathing apparatus due to toxic chemical fumes
Searching illegal drug laboratories presents severe health risks from hazardous chemical vapors, volatile organic solvents, and toxic gases. Safety protocols mandate wearing self-contained breathing apparatus and specialized chemical protective suits to prevent inhalation toxicity, skin exposure, or injury from sudden chemical reactions while processing synthetic drug manufacturing environments.

NODIA

83. (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
Strip search methods are selected for rapid visual sweeps across expansive rural fields when time or resources are constrained. Because searchers traverse terrain along single parallel paths without performing a secondary perpendicular pass, strip searching requires significantly less time than grid searches, providing effective baseline coverage across large areas.

84. (C) Section 174 CrPC / Section 194 BNSS
Inquest proceedings detailing deceased body orientation, surrounding physical evidence, and apparent injury causes are recorded under Section 174 of the Code of Criminal Procedure or Section 194 of the Bharatiya Nagarik Suraksha Sanhita. Preparing panchnamas under judicial supervision provides official statutory documentation of preliminary body findings.

85. (B) II and III only
Scene sketches provide spatial measurements and exact distance relationships between physical items that two-dimensional photographs cannot capture entirely. Outer perimeters should be established broadly to encompass potential exit routes. Once physical evidence has been moved, re-placing items to photograph them is prohibited as it compromises photographic authenticity.

86. (D) Zone search
Zone search methodology conceptualizes complex environments hierarchically by dividing macro-scenes, such as an entire multi-story residence, into smaller micro-scenes like specific rooms, vehicles, or localized bloodstain areas. This structured breakdown enables systematic allocation of investigative personnel and tailored application of secondary search techniques within each defined micro-zone.

87. (B) P-2, Q-1, R-4, S-3
Removing unauthorized personnel prevents physical evidence destruction or theft. Taping perimeters provides clear visual boundaries to exclude spectators. Creating designated access pathways minimizes foreign footwear impressions across search areas. Establishing command posts provides centralized locations between outer cordons to coordinate search activities and safely store equipment.

88. (B) I, II, and IV
Crime scene entry logs must be maintained continuously until official scene release, recording entering personnel names, designations, and departmental affiliations. Detailed entry logs establish access control accountability and defend against legal claims of contamination during trial proceedings. Signatures of waiting media personnel are unnecessary and excluded from logs.

89. (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
Disposable shoe covers or booties represent mandatory protective equipment during indoor scene searches. Wearing booties prevents investigators from transferring foreign soil or trace materials from outdoor footwear onto search surfaces, while simultaneously protecting officers' footwear from exposure to biohazardous fluids, blood, or toxic chemicals present within scenes.

90. (A) I and II only
The final walkthrough functions as an operational audit conducted before releasing scene control. Objectives include confirming all evidence markers have been collected, verifying no equipment was abandoned, and ensuring all required search steps were completed. Interrogating suspects belongs to formal investigative interviews and is not a walkthrough objective.

www.nodia.in

Click Here to Buy book on Flipkart

CHAPTER 06
Documentation of the Crime Scene

1. What is the most critical purpose of documenting a crime scene?
(A) To provide media personnel with visual aids for news reporting
(B) To permanently record the condition of the scene and the physical relationships of evidence
(C) To determine the immediate guilt or innocence of the suspect
(D) To eliminate the need for physical evidence collection

2. Which of the following is NOT a standard, formally recognized method of crime scene documentation?
(A) Detailed handwritten notes
(B) Still photography
(C) Dimensional sketching
(D) Live-streamed social media video

3. What is the fundamental rule for correcting an error in handwritten crime scene notes?
(A) Draw a single line through the error, initial it, and write the correction adjacent to it
(B) Erase the error completely and write the correct information over it
(C) Use a white correction fluid to mask the error and rewrite
(D) Tear out the page containing the error and start a new page

4. In crime scene note-taking, what information is typically recorded under administrative data?
(A) The exact measurements between a weapon and a deceased victim
(B) The chronological order of photographs taken
(C) The case number, date, time of arrival, and names of assigned personnel
(D) The detailed description of blood spatter patterns

5. Match the crime scene documentation elements in List I with their primary descriptions in List II.
List I: (Element)
P. Chronological log
Q. Administrative notes
R. Transient evidence notes
S. Condition of evidence
List II: (Description)
1. Odours, temperatures, and melting ice
2. Time of arrival, search start time, and departure time
3. Case number, location address, and personnel names
4. Presence of stains, damage, or trace materials on an item
(A) P-2, Q-3, R-1, S-4
(B) P-3, Q-2, R-1, S-4
(C) P-2, Q-3, R-4, S-1
(D) P-3, Q-1, R-2, S-4

6. Why is it essential to document weather and lighting conditions in crime scene notes upon arrival?
(A) To evaluate working conditions and calculate overtime compensation for personnel
(B) To justify utilizing high-cost photographic apparatus and lens equipment
(C) Because weather conditions dictate which specific sketch format must be chosen
(D) Because they affect evidence degradation, scene visibility, and witness observations

7. According to standard crime scene protocol, when should the initial note-taking process begin?
(A) Only after all physical evidence at the scene has been fully collected
(B) Immediately upon receiving the call to respond to the incident scene
(C) After the preliminary rough sketch of the crime scene is completed
(D) When the first responder eventually returns to the police station

8. Which physical parameter in a camera lens controls the amount of light passing through to the image sensor by adjusting the size of its opening?
(A) ISO

NODIA

(B) Shutter speed
(C) Aperture
(D) Focal length

9. What is the primary objective of forensic photography at a crime scene?
(A) To produce aesthetically pleasing artistic images suitable for public exhibition
(B) To emphasize the gruesome nature of the violent crime for courtroom display
(C) To intentionally minimize the visual appearance of blood spatters and physical injuries
(D) To capture an accurate representation of the scene and evidence

10. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Using a smaller aperture opening (a higher f-stop number) increases the depth of field in a photograph.
Reason (R): A smaller aperture narrows the angle of light entering the lens, which expands the range of distance that appears acceptably sharp.
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(B) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

11. In digital photography, increasing the ISO setting has which of the following effects?
(A) It decreases the digital camera sensor's sensitivity to light while significantly reducing image noise
(B) It increases light sensitivity but may introduce digital noise or grain
(C) It expands the overall depth of field across the frame without altering sensor light sensitivity
(D) It physically widens the mechanical aperture opening located within the camera lens assembly

12. If a forensic photographer needs to freeze the motion of a fast-moving object, which camera setting should be adjusted?
(A) Select a slow shutter speed (e.g., 1/15 second)
(B) Set a high shutter speed (e.g., 1/1000 second)
(C) Increase the optical focal length of the lens
(D) Select a lower sensor ISO sensitivity value

13. What is the standard purpose of taking overall photographs at a crime scene?
(A) To capture the overall layout, boundaries, and condition of the scene
(B) To clearly demonstrate spatial relationships between separate physical items of evidence
(C) To completely fill the camera frame with a single isolated piece of trace evidence
(D) To thoroughly document delicate latent fingerprints prior to applying lifting techniques

14. Which statement correctly describes a mid-range photograph?
(A) It encompasses the complete exterior perimeter and surrounding structure of a building
(B) It provides a highly detailed 1:1 macro close-up view of a microscopic tool mark
(C) It shows an item of evidence relative to a fixed feature in the scene
(D) It is captured exclusively from a high-altitude overhead aerial photography perspective

15. Consider the following statements regarding the principles of crime scene photography:
I. Photographs must be taken in an unaltered state before anything is moved or collected.
II. A scale should be included in the very first overall photograph taken at the scene.
III. Close-up photographs of evidence should ideally be taken both with and without a scale.
Which combination of statements is correct?
(A) I and II only
(B) I and III only
(C) II and III only
(D) I, II, and III

16. When taking a close-up photograph of a footwear impression, why must the camera be positioned exactly perpendicular (90 degrees) to the impression?
(A) To ensure the electronic flash output completely washes out background features
(B) To artificially enhance and increase the apparent physical depth of the impression
(C) To minimize perspective distortion and enable accurate measurement
(D) To intentionally obscure distracting

NODIA

background details around the impression area

17. The ABFO No. 2 scale is most commonly associated with the photographic documentation of which type of evidence?
(A) Overall bloodstain spatter patterns on a vertical wall
(B) Bite marks and pattern injuries on skin
(C) Large vehicular tire tread impression tracks
(D) Microscopic hair fibers and trace filaments

18. What critical piece of information is recorded in a photographic log?
(A) The exact chemical composition and manufacturer details of the photographic film
(B) The specific brand name, model number, and capacity of the digital memory card used
(C) The complete chain of custody and equipment maintenance log for the camera hardware
(D) A description of each photo, frame number, and camera settings

19. When photographing a deceased person at a crime scene, which of the following is the correct procedure?
(A) Photograph the body in the exact position it was found from all possible angles
(B) Move the body immediately to a clean area to take clear photographs
(C) Only photograph the face for identification purposes
(D) Remove the victim's clothing before taking the first photograph to show hidden injuries

20. Select the correct sequential order of taking photographs at a typical crime scene:
(A) Close-up with scale → Close-up without scale → Mid-range → Overall
(B) Overall → Mid-range → Close-up without scale → Close-up with scale
(C) Mid-range → Overall → Close-up with scale → Close-up without scale
(D) Overall → Close-up with scale → Mid-range → Close-up without scale

21. What lighting technique is most effective for photographing three-dimensional evidence such as latent shoe prints in dust or tool marks?
(A) Oblique (side) lighting
(B) Direct overhead flash
(C) Backlighting
(D) Diffused ambient lighting

22. In the context of evidence photography, what does fill-flash mean?
(A) Using an intense electronic flash unit to completely white-out the background environment
(B) Triggering the camera flash repeatedly in rapid succession to test internal battery capacity
(C) Filling the entire camera frame composition with direct reflections from the flash bulb
(D) Using flash to illuminate dark shadows created by primary lighting

23. What type of filter is generally required on the camera lens when photographing evidence using ultraviolet (UV) or alternate light sources (ALS) to capture fluorescence?
(A) A high-grade linear or circular polarizing lens filter
(B) A barrier filter matching the wavelength used
(C) A neutral density filter designed to uniformly reduce light intensity
(D) A multi-point starburst effect filter attached to the camera lens

24. Which wavelength range represents the ultraviolet (UV) spectrum utilized in forensic photography for detecting trace evidence like semen or saliva?
(A) 10 nm to 100 nm
(B) 200 nm to 400 nm
(C) 400 nm to 700 nm
(D) 700 nm to 900 nm

25. Consider the following statements regarding the photography of injuries on a living victim:
I. Written consent must be obtained before photographing sensitive areas.
II. A color rendition chart and scale should be included in the photographs.
III. The photographer should use the highest ISO possible to capture deep tissue detail.
IV. Follow-up photographs over several days are often required to document bruising development.
Which combination of statements is correct?
(A) I, II, and III
(B) I, II, and IV
(C) II, III, and IV
(D) I, III, and IV

Downloaded from www.pdf.tube

26. Which type of photography uses wavelengths longer than 700 nm and is particularly useful for detecting gunshot residue on dark clothing or differentiating inks in questioned documents?
(A) Infrared photography
(B) Ultraviolet photography
(C) X-ray photography
(D) Fluorescence photography

27. What is photogrammetry in the context of forensic science?
(A) The chemical processing of film to extract latent images
(B) The use of photography to extract 3D measurements and spatial data
(C) The process of recovering deleted digital photos from a mobile device
(D) The psychological analysis of a photograph's subject

28. Which of the following defines macro photography as used in forensic laboratories for examining trace evidence?
(A) Taking aerial photographs of outdoor crime scenes using an airplane, helicopter, or drone
(B) Producing an image on the sensor at 1:1 magnification or greater
(C) Stitching multiple overlapping photographs together to form a seamless wide panorama
(D) Utilizing an extreme wide-angle focal lens to capture the interior of a small room

29. What is a primary consideration when utilizing a drone for aerial crime scene photography?
(A) Adhering to drone regulations and obtaining proper flight clearances
(B) Restricting drone operations strictly to altitudes below fifty feet above ground level
(C) Utilizing only specialized black and white film emulsions to artificially enhance contrast
(D) Conducting flight missions strictly during nighttime hours to avoid public observation

30. Match the specialized photography techniques in List I with their appropriate forensic applications in List II.
List I: (Technique)
P. Oblique lighting
Q. Infrared photography
R. Cross-polarization
S. Ultraviolet photography
List II: (Application)
1. Detecting latent bloodstains or semen on fabrics
2. Enhancing contrast of tire tracks in soil
3. Eliminating glare from reflective surfaces like glass or water
4. Visualizing obscured writing under obliterations
(A) P-2, Q-4, R-3, S-1
(B) P-1, Q-3, R-2, S-4
(C) P-4, Q-2, R-1, S-3
(D) P-2, Q-1, R-3, S-4

31. What is the standard protocol regarding audio recording during crime scene videography?
(A) Audio should be continuously recorded throughout the walkthrough to capture the investigation team's subjective opinions
(B) A portable broadcast radio should be played continuously in the background to establish verifiable time documentation
(C) The victim's family members should be formally interviewed directly on the primary crime scene audio track
(D) Audio is muted or restricted to factual narration to avoid improper comments

32. In crime scene videography, what is meant by the rule of slow, continuous panning?
(A) Moving the camera rapidly in order to capture all boundaries of the entire scene within under one minute total runtime
(B) Recording the video exclusively in a high-speed slow-motion format such as 120 or 240 frames per second
(C) Moving the camera smoothly and slowly to ensure clarity and avoid distortion
(D) Instructing the camera operator to continuously walk backwards while sweeping the camera sideways

NODIA

33. To ensure the authenticity and integrity of digital crime scene photographs, what mathematical algorithm is often applied to the image files immediately upon transfer?
(A) Fast Fourier Transform algorithm
(B) Hashing (e.g., MD5 or SHA-256)
(C) Gaussian Blur image filtration
(D) Polynomial Regression modeling

34. What is EXIF data in relation to digital forensic photography?
(A) A specialized software program used to edit out or mask unwanted background elements in photos
(B) A physical optical glass filter attached directly to the front element of the camera

lens
(C) The physical handwritten logbook maintained by the forensic photographer during field work
(D) Metadata embedded in the file containing camera settings, time, and location

35. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Digital crime scene images should ideally be captured and stored in a lossless format like RAW or TIFF.
Reason (R): Lossless formats compress the image by discarding minor pixel data, thus saving storage space without affecting visual quality.
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(B) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

36. Which documentation step serves to demonstrate the specific layout of a scene and the exact spatial relationships between evidence, removing unnecessary visual clutter?
(A) The chronological log
(B) The overall photograph
(C) The crime scene sketch
(D) The physical evidence receipt

37. What distinguishes a rough sketch from a finished sketch?
(A) A rough sketch is drawn at the scene; a finished sketch is a polished, court-ready version
(B) A rough sketch is always drawn to exact mathematical scale at the scene, whereas a finished sketch is drawn without scale
(C) A rough sketch relies exclusively on digital software tools, whereas a finished sketch must be drawn entirely by hand
(D) A rough sketch intentionally omits all administrative title blocks, directional compass arrows, and explanatory legends

38. Which of the following is NOT typically included in the title block of a crime scene sketch?
(A) Case number
(B) Name of the victim
(C) Name and agency of the sketch artist
(D) Name of the suspect

39. What is the purpose of the Legend in a crime scene sketch?
(A) To provide a detailed chronologically ordered narrative summary of the suspected crime
(B) To explain symbols and labels used for evidence in the sketch
(C) To state the specific mathematical formulas and geometric calculations used for spatial measurements
(D) To list the full names, ranks, and agency affiliations of all police officers present at the scene

40. Consider the following statements regarding crime scene sketching:
I. Every sketch must include a compass symbol indicating magnetic North.
II. A scale indicator or the phrase "Not to Scale" must be present on the sketch.
III. Measurement lines should intersect as frequently as possible to save space on the paper.
Which combination of statements is correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

41. In an indoor crime scene with straight, perpendicular walls, which measurement method is most commonly used by mapping the distance of an object from two adjacent walls?
(A) Triangulation measurement method
(B) Polar coordinate mapping method
(C) Transecting baseline mapping method
(D) Rectangular coordinate method

42. When using the triangulation method for crime scene measurement, how many fixed reference points are required to plot a single piece of evidence?
(A) One
(B) Two
(C) Three
(D) Four

43. Which sketching perspective is best suited to document blood spatter on the walls and ceiling of a room along with evidence on the floor?
(A) Vertical elevation view sketch
(B) Cross-projection (exploded) sketch
(C) Three-dimensional laser scanner render

Click Here to Buy book on Amazon

(D) Standard floor plan (bird's-eye view) sketch

44. What characterizes the baseline method of crime scene measurement?
(A) Measuring the exact distance of an evidence item from two designated fixed corners of a room
(B) Measuring evidence at right angles from a line between two fixed points
(C) Utilizing an optical transit instrument to record angles and distances relative to a central datum point
(D) Folding the interior room walls flat downward in the drawing layout to illustrate vertical spatial evidence

45. Arrange the following steps for documenting a digital crime scene photograph's authenticity from capture to court:
I. Generate a hash value of the original image file.
II. Capture the image in a lossless format at the scene.
III. Present the original image alongside the hash verification report in court.
IV. Transfer the image to secure, write-blocked law enforcement storage.
Which of the following represents the correct sequence?
(A) II, I, IV, III
(B) II, IV, I, III
(C) I, II, IV, III
(D) II, I, III, IV

46. The polar coordinate method of crime scene measurement requires the recording of which two specific parameters from a datum point?
(A) Two horizontal distances
(B) Two angles
(C) One distance and one angle (azimuth)
(D) Vertical elevation height and horizontal surface width

47. Which measurement technology employs an electronic transit equipped with an electronic distance meter (EDM) to measure angles and slope distances, often used in large outdoor scenes like traffic accidents?
(A) Photogrammetry mapping
(B) Cross-projection drafting
(C) Baseline tape mapping
(D) Total Station

48. What is the primary output generated by a 3D laser scanner at a crime scene?
(A) A single continuous two-dimensional panoramic composite photograph of the scene
(B) A comprehensive written chronological log detailing all activities at the scene
(C) A detailed point cloud of 3D spatial measurements
(D) A preliminary chemical analysis report identifying collected trace evidence items

NODIA

49. When completing a rough sketch, an investigator uses a large, immovable oak tree as a reference point. In sketching terminology, what is this tree called?
(A) A transient point
(B) A fixed point
(C) A polar point
(D) A secondary point

50. Consider the following statements about crime scene documentation protocols:
I. The rough sketch should be completed before physical evidence is moved or collected.
II. 3D laser scanning eliminates the requirement to take any standard digital photographs.
III. Notes taken at the scene should be written in ink, not pencil, to prevent unauthorized alteration.
IV. The finished sketch is usually prepared drawn to scale using drafting tools or CAD software.
Which combination of statements is correct?
(A) I, II, and III
(B) I, III, and IV
(C) II, III, and IV
(D) I, II, and IV

51. What is legally required for digital crime scene photographs to be admissible in a court of law?
(A) A certificate verifying the proper operation of the electronic device
(B) The actual physical digital camera hardware used at the scene must be surrendered to the judge
(C) The captured digital photographs must be physically printed on certified forensic-grade glossy paper
(D) The operating photographer must possess a recognized university degree in formal digital forensics

52. Why must crime scene notes, photographs, and sketches be cross-verified before the scene is released?
(A) To ensure that no two investigating officers independently record identical descriptive information
(B) To prepare a unified official press release statement for distribution to media agencies
(C) To ensure measurements, locations, and details are consistent across all records
(D) To formally justify allocating specialized forensic laboratory resources and analytical time

53. If a forensic expert is documenting an invisible bloodstain detected using Luminol, what specific camera adjustment is crucial?
(A) Using a long camera exposure time on a tripod
(B) Setting the camera to a high-speed focal-plane shutter setting
(C) Firing multiple high-intensity external electronic flashes continuously
(D) Attaching a specialized ultraviolet bandpass barrier lens filter

54. When photographing a latent fingerprint developed with black powder on a mirror, what is the best technique to prevent the camera's reflection from appearing in the photo?
(A) Stand directly in front of the mirror with a powerful flash
(B) Use a wide-angle lens from a distance
(C) Paint the mirror black before photographing
(D) Use a polarizing filter and angle the camera slightly

55. Match the camera lenses or components in List I with their primary uses in List II.
List I: (Lens/Component)
P. 50mm fixed lens
Q. Macro lens
R. Wide-angle lens
S. Ring flash
List II: (Primary Use)
1. Providing even, shadowless illumination for extreme close-ups
2. Approximating the normal visual field of the human eye
3. Capturing fine details of trace evidence at 1:1 ratio
4. Capturing small, confined indoor scenes like a bathroom
(A) P-2, Q-3, R-4, S-1
(B) P-3, Q-2, R-1, S-4
(C) P-4, Q-1, R-2, S-3
(D) P-2, Q-4, R-3, S-1

56. What type of distortion occurs when using a very wide-angle lens, causing straight lines near the edges of the frame to bow outward?
(A) Pincushion distortion
(B) Chromatic aberration
(C) Barrel distortion
(D) Motion blur

57. In a crime scene sketch, how are doors typically represented?
(A) As a prominent bold 'X' mark drawn directly across a solid wall boundary line
(B) As a straight reference line drawn perpendicular to the main interior wall line
(C) As a solid shaded rectangular box colored red to denote an opening feature
(D) As a gap in the wall line with a curved swing line

58. Which of the following is considered transient evidence and must be documented immediately upon arrival?
(A) The smell of an accelerant at an arson scene
(B) A bullet deeply embedded within a structural concrete support wall
(C) A large pool of thoroughly dried blood on a tile floor
(D) A discarded semi-automatic firearm lying in an open field

59. While documenting a crime scene in an open agricultural field, a sudden heavy rainstorm begins. What is the most appropriate immediate action for the forensic assistant?
(A) Wait out the heavy rainstorm inside the police vehicle and attempt complete documentation later
(B) Cover fragile evidence to protect it, documenting as protection is applied
(C) Rush to collect all physical evidence immediately without taking notes or photos to prevent water damage
(D) Formally declare the scene as hopelessly compromised and return immediately to the forensic laboratory

60. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): When photographing an evidence

Downloaded from www.pdf.tube

scale in a close-up shot, the scale must be placed on the same plane as the evidence.
Reason (R): Placing the scale on a different plane alters the optical focus and creates perspective distortion, leading to inaccurate life-size 1:1 reproductions.
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(B) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

61. What is the standard scientific unit used when recording blood alcohol concentration (BAC) in forensic toxicology documentation?
(A) Milligrams per decilitre (mg/dL)
(B) Millilitres per gram of tissue mass (mL/g)
(C) Micrograms per litre of liquid volume (µg/L)
(D) Parts per million of total solution (ppm)

62. Which of the following is an unacceptable fixed point for triangulating measurements at a traffic accident scene?
(A) A municipal fire hydrant
(B) The corner of a permanent concrete building
(C) A fully loaded parked delivery truck
(D) A deep-set utility pole

63. "Painting with light" is a specialized photographic technique primarily used in which scenario?
(A) Detailed microscopic examination and morphological evaluation of trace hair fibres
(B) Developing low-contrast latent fingerprints using specialized fluorescent dusting powders
(C) High-speed ballistic capture of a projectile bullet moving in mid-flight trajectory
(D) Dark, large crime scenes requiring illumination over multiple exposures

64. When narrating a crime scene video, which type of statement is strictly prohibited?
(A) "We are currently entering the primary master bedroom located on the second floor."
(B) "The exact official time recorded for the walkthrough is currently 14:30 hours."
(C) "This stain proves the suspect committed the murder."
(D) "There is an uncollected kitchen knife located immediately near the north interior wall."

65. Consider the following statements regarding the triangulation method of measurement:
I. It requires measuring the distance from an object to two fixed reference points.
II. The two fixed points and the object form a triangle.
III. It is completely ineffective for outdoor crime scenes.
Which combination of statements is correct?
(A) I and II only
(B) I and III only
(C) II and III only
(D) I, II, and III

66. A forensic assistant is estimating the time since death to document in notes. The body temperature is 31.0°C and the ambient environment is 20°C. Using a standard assumption that body temperature drops approximately 1.5°C per hour post-mortem, roughly how long has the victim been dead? (Assume normal body temperature was 37.0°C).
(A) 2 hours
(B) 4 hours
(C) 8 hours
(D) 12 hours

NODIA

67. How should a forensic officer photograph a blood trail that spans a long distance down a hallway?
(A) Take a series of overlapping photographs along the trail
(B) Take a single photograph from the start of the hallway using a wide-angle lens
(C) Only photograph the beginning and end of the blood trail
(D) Use macro photography to document the entire length

68. The term "depth of field" in forensic photography specifically refers to:
(A) The exact physical distance measured between the camera lens element and the primary subject
(B) The precise mathematical ratio of the lens focal length divided by the active aperture diameter
(C) The range of distance that appears acceptably sharp and in focus
(D) The overall horizontal and vertical field of view captured when using a wide-angle camera lens

69. Why is changing camera lenses frequently discouraged at a dusty, outdoor crime scene?

(A) It exposes the camera sensor to dust, creating spots on future images
(B) It severely disrupts and corrupts the strict chronological ordering recorded in the photographic log
(C) It consumes excessive scene processing time, thereby significantly delaying the scheduled autopsy
(D) It permanently invalidates and corrupts the cryptographic hash verification value of the memory card

70. Select the correct sequence of actions for a first responder documenting an indoor crime scene:
(A) Enter and treat the victim → Photograph the weapon → Collect the weapon → Draw a rough sketch
(B) Enter and treat the victim → Secure the scene → Note the condition of doors/lights/smells → Establish a perimeter
(C) Secure the scene → Draw a rough sketch → Photograph the scene → Enter and treat the victim
(D) Establish a perimeter → Collect transient evidence → Treat the victim → Take notes

71. When using a transecting baseline to map a large outdoor scene, how is the baseline ideally established?
(A) By wrapping a measuring tape around the perimeter of the scene
(B) By laying a measuring tape exactly between two fixed reference points
(C) By walking roughly from one end of the scene to the other counting paces
(D) By using a GPS device to mark a single point in the center

72. Which documentation method involves the use of string, lasers, or 3D scanning to reconstruct the flight path of a projectile?
(A) Bloodstain pattern morphology analysis
(B) Forensic entomological evidence mapping
(C) Bullet trajectory documentation
(D) Baseline transecting measurement method

73. What is the standard file format for saving a finalized, CAD-generated crime scene sketch to ensure it cannot be easily altered?
(A) .DOCX
(B) .TXT
(C) .XLSX
(D) .PDF

74. When photographing an overall view of an automobile involved in a crime, how many photographs are minimally required to document its complete exterior?
(A) 6 (Four corners plus front and back)
(B) 2 (One straight-on front photo and one straight-on back photo)
(C) 4 (One direct orthogonal photograph taken from each side)
(D) 1 (A single continuous 360-degree panoramic composite shot)

75. Consider the following statements regarding digital forensic evidence integrity:
I. A write-blocker prevents data from being accidentally modified on a storage drive during extraction.
II. Altering the contrast of an image for clarity in a forensic report permanently deletes the original file.
III. MD5 and SHA-1 are common cryptographic hash functions used to verify digital file integrity.
IV. Digital enhancement of a photograph for court presentation requires logging all steps taken.
Which combination identifies the correct statements?
(A) I, II, and III
(B) I, III, and IV
(C) II, III, and IV
(D) I, II, and IV

76. In crime scene notes, how should an investigator describe a suspected bloodstain found on the floor before laboratory confirmation?
(A) "A patch of human blood on the tile."
(B) "A red/brown stain."
(C) "A red liquid resembling blood."
(D) "The victim's blood."

77. Which optical phenomenon must be avoided when taking a close-up photograph by ensuring the camera sensor plane is parallel to the evidence plane?
(A) Perspective distortion
(B) Transverse chromatic aberration
(C) Spherical optical aberration
(D) Optical peripheral vignetting

78. When measuring a body on a crime scene sketch, from which anatomical points are measurements typically taken to fix its position?
(A) The top of the head and the center of mass

Click Here to Buy book on Flipkart

(navel)
(B) Both wrists and both ankles
(C) The top of the head and the center of the heels
(D) The left shoulder and the right hip

79. Why is videography considered supplementary rather than a complete replacement for still photography at a crime scene?
(A) Digital video files are automatically deemed inadmissible as evidence in court proceedings
(B) Standard videography cameras are fundamentally incapable of operating under low-light scene conditions
(C) Recorded video files cannot be securely duplicated without inherently altering digital checksum integrity
(D) Lower video resolution lacks the high detail required for close-up forensic analysis

80. Match the crime scene documentation techniques in List I with their primary strengths in List II.
List I: (Technique)
P. Still Photography
Q. Videography
R. Rough Sketch
S. 3D Laser Scanning
List II: (Strength)
1. Provides exact spatial relationships and removes visual clutter
2. Offers a smooth, real-time visual walkthrough of the scene layout
3. Captures high-resolution, static true representations of evidence
4. Creates an immersive, highly accurate virtual model of the scene
(A) P-3, Q-2, R-1, S-4
(B) P-2, Q-3, R-1, S-4
(C) P-3, Q-1, R-2, S-4
(D) P-1, Q-2, R-4, S-3

81. If an investigator uses a scale that is marked in inches instead of centimetres during crime scene photography, what is the consequence?
(A) The photograph is rendered completely inadmissible in court proceedings due to unit non-standardization
(B) The photograph remains valid if the scale unit is clearly visible and standard
(C) The photograph must be post-processed and digitally altered to convert the scale into centimetres
(D) The physical evidence shown can no longer be subjected to comparative physical matching techniques

82. Which of the following is a classic example of an administrative error in crime scene documentation?
(A) Using a flashlight to illuminate a dark room
(B) Drawing a sketch using the baseline method instead of triangulation
(C) Taking an overall photograph without a scale
(D) Mislabeling the case number on the photographic log

83. The process of calculating the magnification of a microscope or a macro photograph involves matching the size of the image on the sensor to the real size of the object. If an object is 10mm long and its image on the sensor is 5mm long, what is the magnification ratio?
(A) 1:2
(B) 2:1
(C) 1:1
(D) 5:1

84. When documenting a hanging body at a crime scene, what critical detail regarding the ligature must be noted and photographed before the body is cut down?
(A) The brand name of the rope
(B) The chemical composition of the rope material
(C) The exact location and type of the knot
(D) The exact weight the rope can hold

85. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): The photographic log constitutes an essential part of the chain of custody.
Reason (R): It records exactly who took the photograph, when it was taken, and ensures accountability for the integrity of the image data.
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(B) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

86. How should an investigator mark evidence locations in a rough sketch prior to collection?
(A) By drawing detailed artistic representations

Downloaded from www.pdf.tube

of the items
(B) By taping the actual evidence to the sketch paper
(C) By writing the full description of the item directly on the floor plan
(D) By using numbers or letters corresponding to a legend

87. What does the term "orientation" specifically mean in the context of a crime scene sketch?
(A) Pointing the top edge of the sketch drawing directly toward the location of the primary victim
(B) Aligning the sketch with cardinal directions, indicating magnetic North
(C) Ensuring that the physical sketch paper is kept perfectly horizontal during the drafting process
(D) Orienting the primary axis of the sketch toward the main exterior entrance of the building structure

88. Consider the following statements about depth of field in photography:
I. Depth of field increases as the focal length of the lens increases.
II. Depth of field increases as the camera-to-subject distance increases.
III. Depth of field decreases when a wider aperture (smaller f-stop number) is used.
Which combination of statements is correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

89. Which specialized documentation technique involves capturing a sequence of images at different focal lengths and combining them digitally to create a single image with extended depth of field?
(A) Photogrammetry
(B) High Dynamic Range (HDR) imaging
(C) Panoramic stitching
(D) Focus stacking

90. Arrange the following actions to construct a comprehensive crime scene documentation workflow:
I. Conduct an initial walkthrough to assess the scene without disturbing evidence.
II. Photograph the scene (overall, mid-range, close-up).
III. Prepare a rough sketch with accurate measurements.
IV. Collect, package, and document the physical evidence.
Which of the following represents the correct logical sequence?
(A) I, III, II, IV
(B) I, II, III, IV
(C) II, I, III, IV
(D) I, II, IV, III

www.nodia.in

NODIA

ANSWERS

1. (B) To permanently record the condition of the scene and the physical relationships of evidence
Documenting a crime scene creates an immutable and objective record of all physical elements prior to alteration or evidence recovery. Preserving exact environmental conditions and spatial relationships among physical items ensures reconstructive validity for subsequent investigation and judicial evaluation. This permanent baseline allows investigators and court personnel to analyze the original state accurately.

2. (D) Live-streamed social media video
Standard crime scene documentation methods require validated techniques that safeguard evidence integrity, chain of custody, and confidentiality. Standard protocols include detailed written notes, professional still photography, dimensional sketching, video recordings, and laser scanning. Transmitting unverified, unsecure live-streamed video over public social media platforms violates basic evidentiary security standards, compromises ongoing investigations, and exposes sensitive details publicly.

3. (A) Draw a single line through the error, initial it, and write the correction adjacent to it
Handwritten forensic documentation requires complete transparency to maintain integrity and credibility in judicial proceedings. When an error occurs in crime scene notes, the investigator must draw a single strike-through line across the incorrect text, add their initials, and record the correct information alongside. Erasing, obscuring, or destroying original entries raises suspicions of evidence tampering.

4. (C) The case number, date, time of arrival, and names of assigned personnel
Administrative data in forensic documentation establishes the operational context and formal framework of an investigation. This section systematically records fundamental organizational details, including the designated case identification number, exact calendar date, precise arrival time of the investigative team, official location address, and full names and duties of all responding personnel present.

5. (A) P-2, Q-3, R-1, S-4
Crime scene logs record event timing such as arrival and departure hours. Administrative notes detail core identifiers including case numbers, addresses, and team member names. Transient evidence entries capture temporary, fleeting phenomena like odours, ambient temperatures, or melting ice. Condition notes specifically document physical characteristics, stains, damage, or trace elements observed on physical items.

6. (D) Because they affect evidence degradation, scene visibility, and witness observations
Environmental factors present at a crime scene directly influence physical evidence preservation and investigation accuracy. Weather elements such as wind, rain, and temperature variations accelerate evidence degradation or wash away transient traces. Similarly, ambient lighting dictates visual clarity for responding officers and eyewitnesses, establishing baseline conditions necessary to reconstruct events accurately during subsequent judicial evaluations.

7. (B) Immediately upon receiving the call to respond to the incident scene
Forensic note-taking must commence at the earliest point of involvement, specifically when the notification or dispatch call is received. Recording initial details like dispatch time, caller information, initial reports, and travel conditions creates an unbroken chronological timeline. Prompt documentation ensures accurate recall of critical early events before scene contamination or memory decay can occur.

8. (C) Aperture
The aperture is an adjustable mechanical iris diaphragm located within the camera lens structure. By opening wider or narrowing, it regulates the volume of light passing through the optical elements to strike the image sensor. In addition to exposure control, aperture size directly governs the depth of field captured within forensic photographs.

Click Here to Buy book on Amazon

9. (D) To capture an accurate representation of the scene and evidence
Forensic photography serves to create an unmanipulated, true visual depiction of a crime scene and its constituent evidence. The primary objective is to record items exactly as discovered, preserving spatial relationships, physical conditions, and delicate details without artistic alteration or emotional distortion, thereby providing admissible visual evidence for judicial proceedings.

10. (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
Selecting a smaller physical aperture opening, indicated by a larger numerical f-stop setting, increases total depth of field. A constricted opening restricts light rays to a narrower beam passing through the lens center. This reduces circle of confusion size, thereby expanding the distance range in front of and behind the focal plane that appears sharp.

11. (B) It increases light sensitivity but may introduce digital noise or grain
In digital imaging, increasing the ISO setting amplifies the electrical signal generated by the sensor, effectively enhancing light sensitivity for low-light environments. However, amplifying this signal also magnifies electronic background noise, resulting in visible visual grain or pixelated noise across the final image, which can reduce fine detail resolution.

12. (B) Set a high shutter speed (e.g., 1/1000 second)
Freezing rapid physical motion requires exposing the digital sensor for an extremely brief time interval. Setting a high shutter speed, such as one thousandth of a second, minimizes the distance the subject moves while the shutter curtain remains open. This rapid exposure eliminates motion blur, producing crisp, sharply defined images of fast-moving targets.

13. (A) To capture the overall layout, boundaries, and condition of the scene
Overall photographs establish the macro-level context of a crime scene prior to physical entry or evidence collection. These wide-perspective images document exterior perimeters, entry points, room boundaries, and general layout. They provide an overarching visual orientation that links specific physical evidence items to the entire environment in which they were originally located.

14. (C) It shows an item of evidence relative to a fixed feature in the scene
Mid-range photographs establish a spatial bridge between wide-angle overall views and detailed close-ups. Their primary purpose is to illustrate the exact position of a specific piece of evidence relative to fixed environmental landmarks, such as doors, windows, or heavy furniture, clearly establishing spatial context and relative distance within the scene.

15. (B) I and III only
Photographs must record the scene in its unaltered state before evidence is touched or collected. Close-up photographs should be taken first without scales to capture unadulterated evidence, followed by photos with scales for dimensional reference. Placing scales in initial overall photographs is avoided because overall shots focus on layout rather than item scale.

16. (C) To minimize perspective distortion and enable accurate measurement
Positioning the camera sensor parallel to the plane of a footwear impression at a precise ninety-degree angle prevents perspective distortion. Angular tilting foreshortens dimensions and distorts shape relationships, making accurate physical measurements impossible. Perpendicular orientation preserves true geometric proportions, ensuring that photographically documented impressions can be reliably compared against reference footwear evidence in forensic examinations.

17. (B) Bite marks and pattern injuries on skin
The ABFO No. 2 scale, developed by the American Board of Forensic Odontology, is specifically designed for documenting bite marks and patterned skin injuries. Featuring L-shaped metric arms, circular distortion check markings, and grayscale elements, it allows forensic experts to correct perspective distortion and accurately analyze injury dimensions during comparative examinations.

18. (D) A description of each photo, frame number, and camera settings
A photographic log maintains a continuous, detailed inventory of every exposure taken at a crime scene. It systematically records key

NODIA

technical information including unique frame numbers, sequential shot order, specific subject descriptions, location details, shutter speeds, aperture values, ISO settings, lens focal lengths, and camera orientation for future evidentiary verification.

19. (A) Photograph the body in the exact position it was found from all possible angles
Documenting a deceased individual requires capturing the body in its undisturbed state prior to handling. Investigators must take comprehensive photographic series from multiple angles and elevations, including overall, mid-range, and close-up views. This documents body position, post-mortem changes, injuries, surface clothing, and physical relationships to surrounding physical items.

20. (B) Overall → Mid-range → Close-up without scale → Close-up with scale
Standard photographic sequence follows a systematic progression from general to specific context. Photographers begin with wide overall shots to establish scene layout, move to mid-range views showing evidence positioning, proceed to close-ups without scales to show unaltered evidence, and conclude with close-ups including scales to establish accurate size measurements.

21. (A) Oblique (side) lighting
Oblique lighting involves positioning a light source at a shallow, low angle relative to the surface being documented. This side-angle illumination casts distinct shadows within subtle surface relief features, highlighting three-dimensional contours, textures, shallow depressions, and fine details in tire tracks, tool marks, and dust impression evidence.

22. (D) Using flash to illuminate dark shadows created by primary lighting
Fill-flash is a photographic lighting technique used to balance high-contrast outdoor or indoor environments. When intense ambient illumination creates dark, heavy shadows across critical evidence areas, triggering a supplementary flash fills in those shadow zones with light, ensuring soft shadow reduction and clear detail visibility across the entire photographic frame.

23. (B) A barrier filter matching the wavelength used
When utilizing alternate light sources or ultraviolet radiation to excite fluorescence in biological fluids or latent prints, intense excitation wavelengths obscure faint emissions. Mounting a barrier filter on the camera lens blocks reflected light of the primary excitation band while allowing lower-intensity fluorescent emissions to pass through to the sensor clearly.

24. (B) 200 nm to 400 nm
The ultraviolet light spectrum spans electromagnetic wavelengths from approximately 100 nanometres to 400 nanometres, with the forensic application range generally operating between 200 nm and 400 nm. Energy within this spectrum induces intrinsic fluorescence in various biological materials, body fluids, latent fingerprints, and trace fibers, aiding non-destructive photographic detection.

25. (B) I, II, and IV
Photographing injuries on living victims requires written informed consent, especially when documenting sensitive body areas. Utilizing color rendition charts and scales ensures accurate size and color calibration. Follow-up photography over multiple days documents bruise evolution and color transformations. High ISO settings should be avoided as they introduce noise that degrades detail.

26. (A) Infrared photography
Infrared photography utilizes electromagnetic wavelengths exceeding 700 nanometres, beyond visible light spectrum limits. Infrared radiation penetrates or reflects differently off varied dyes, dark pigments, soot, and gunshot residue. This specialized imaging enables visualization of obscured writing, ink differentiation on questioned documents, and clear identification of propellant residue patterns deposited on dark fabric surfaces.

27. (B) The use of photography to extract 3D measurements and spatial data
Photogrammetry is the science and technique of extracting reliable geometric measurements and three-dimensional spatial coordinates from overlapping two-dimensional photographs. By mathematically analyzing common reference points across multiple image angles, forensic experts generate precise 3D scene models,

Downloaded from www.pdf.tube

evaluate spatial arrangements, measure physical evidence dimensions, and reconstruct complex accident or crime events.

28. (B) Producing an image on the sensor at 1:1 magnification or greater
Macro photography in forensic science refers specifically to close-up imaging where the life-size magnification ratio of the physical subject onto the camera image sensor is at least 1:1 or higher. This high-magnification technique captures extreme close-up details of minute physical evidence such as tool marks, fiber structures, and tiny fragments.

29. (A) Adhering to drone regulations and obtaining proper flight clearances
Deploying unmanned aerial vehicles for crime scene documentation requires strict adherence to aviation regulations, airspace restrictions, licensing standards, and privacy laws. Photographers must obtain official flight authorizations and maintain operational safety protocols to ensure that aerial visual evidence collected from drones is legally compliant and fully admissible in judicial proceedings.

30. (A) P-2, Q-4, R-3, S-1
Oblique lighting uses low-angle illumination to highlight shadow contrast in tire tracks. Infrared photography reveals faint writing hidden beneath dark ink obliterations. Cross-polarization uses polarizing filters to eliminate harsh glare from reflective surfaces like glass or water. Ultraviolet photography exposes fluorescing biological fluids like semen or latent bloodstains on background fabrics.

31. (D) Audio is muted or restricted to factual narration to avoid improper comments
Standard crime scene videography protocols dictate that audio functions should be muted or strictly limited to deliberate, objective, factual statements. Disabling random audio prevents the recording of off-topic conversations, subjective comments, profanity, or speculative remarks by team members, preserving the scientific integrity and court admissibility of the video documentation.

32. (C) Moving the camera smoothly and slowly to ensure clarity and avoid distortion
Executing slow, continuous panning during crime scene videography ensures smooth, stable motion picture recording without motion blur or camera shake. Moving the recording lens slowly and steadily across environmental perspectives maintains optical focus, provides visual clarity for observers, and prevents disorienting viewing experiences during courtroom presentations and analytical reviews.

NODIA

33. (B) Hashing (e.g., MD5 or SHA-256)
Cryptographic hashing algorithms, such as MD5 or SHA-256, calculate unique numerical checksum values based on raw digital file data. Generating a hash value immediately after capturing or transferring image files establishes a digital fingerprint. Any subsequent modification, deletion, or corruption alters this hash value, thereby verifying evidentiary integrity in legal proceedings.

34. (D) Metadata embedded in the file containing camera settings, time, and location
Exchangeable Image File Format (EXIF) data comprises automated metadata embedded within digital image files during capture. It automatically records technical operational parameters, including camera manufacturer, model, exact timestamp, shutter speed, aperture, ISO sensitivity, focal length, flash status, and GPS spatial coordinates, providing objective technical verification of photographic parameters.

35. (C) Assertion (A) is true but Reason (R) is false.
Capturing forensic images in uncompressed, lossless formats like RAW or TIFF preserves all original pixel data recorded by the sensor, maintaining maximum image fidelity. However, lossless formats do not discard pixel data to save space; instead, lossy compression formats like JPEG remove image data, which can introduce artifacts and permanently compromise evidence detail.

36. (C) The crime scene sketch
A crime scene sketch provides a simplified, scaled two-dimensional representation of the scene that highlights critical spatial relationships between physical items and fixed environmental structures. By eliminating distracting visual background clutter present in photographs, sketches present unambiguous measurements, spatial proportions, and clear structural orientations vital for accurate reconstructive analysis.

37. (A) A rough sketch is drawn at the scene; a finished sketch is a polished, court-ready version
A rough sketch is created directly at the crime scene during initial processing, capturing physical measurements, spatial layouts, and evidence locations without requiring exact geometric scaling. Conversely, a finished sketch is a refined, clean presentation version constructed later using drafting equipment or computer software based precisely on scene measurements.

38. (D) Name of the suspect
The title block of a crime scene sketch contains administrative identifiers essential for legal records. Standard inclusions comprise case identification numbers, exact scene location, date, time, weather conditions, and names of assigned investigators or sketch creators. Suspect names are excluded because identity determination is an investigative conclusion rather than factual scene documentation.

39. (B) To explain symbols and labels used for evidence in the sketch
The legend in a crime scene sketch acts as an explanatory key that decodes symbols, letters, or numbers used throughout the drawing. By correlating specific alphanumeric identifiers to exact descriptions of physical evidence items and scene features, the legend ensures that complex spatial diagrams remain clear, concise, and easily interpretable.

40. (A) I and II only
Crime scene sketches must include a directional compass arrow indicating magnetic North to establish spatial orientation. They must also explicitly specify the scale used or state "Not to Scale" to avoid misinterpretation. Measurement lines should never intersect excessively or clutter the drawing, as excessive lines reduce visual clarity and diagram readability.

41. (D) Rectangular coordinate method
The rectangular coordinate method maps physical evidence locations within indoor scenes bounded by mutually perpendicular walls. Measurements are taken at right angles from two adjacent, fixed walls to a specific evidence point. This creates a two-axis Cartesian coordinate system that precisely fixes spatial positions relative to permanent room structures.

42. (B) Two
The triangulation mapping method fixes the position of an evidence item by measuring straight-line distances from two distinct, permanent reference points to the item. These two fixed landmarks and the evidence location form the vertices of a triangle, allowing precise spatial plotting and accurate reconstruction of evidence positions within the scene.

43. (B) Cross-projection (exploded) sketch
A cross-projection or exploded view sketch illustrates a three-dimensional interior space by laying the walls flat outward, continuous with the floor plan. This drafting technique allows investigators to simultaneously document physical evidence located on floor surfaces alongside vertically distributed bloodstain patterns, bullet impacts, or trace marks on surrounding walls and ceilings.

44. (B) Measuring evidence at right angles from a line between two fixed points
The baseline measurement method establishes a straight reference line between two fixed, prominent landmarks within a scene. Evidence items are then mapped by measuring distance along this baseline tape and taking perpendicular, ninety-degree measurements from the line to each physical object, forming an efficient rectangular coordinate system for outdoor layouts.

45. (B) II, IV, I, III
Digital image authentication begins with capturing photographs in an uncompressed lossless format at the scene. Images are then transferred to secure, write-blocked law enforcement storage systems. Next, cryptographic hash values are generated to verify digital data integrity. Finally, original images accompanied by hash verification logs are submitted for courtroom presentation.

46. (C) One distance and one angle (azimuth)
The polar coordinate mapping method fixes evidence locations by measuring two specific variables from a single established datum point. Investigators measure the straight-line distance to the object alongside the horizontal angle or compass azimuth relative to magnetic North, providing precise spatial mapping suitable for large, open outdoor crime scenes.

Click Here to Buy book on Flipkart

47. (D) Total Station
A Total Station is an integrated surveying instrument combining an electronic transit with an electronic distance meter. It rapidly measures slope distances, horizontal angles, and vertical elevations relative to a fixed datum point, making it highly effective for mapping expansive outdoor crime scenes, vehicle collision tracks, and complex terrain with high precision.

48. (C) A detailed point cloud of 3D spatial measurements
A 3D laser scanner captures crime scene geometry by firing millions of laser pulses across surrounding surfaces. Measuring time-of-flight or phase shifts yields a dense collection of three-dimensional spatial coordinates known as a point cloud. This detailed point cloud creates an accurate, interactive digital twin for virtual scene reconstruction and measurement.

49. (B) A fixed point
In forensic mapping terminology, a fixed point is a permanent, stationary, and immovable landmark used as an anchor reference for spatial measurements. Features like mature trees, building corners, utility poles, or concrete structures serve as fixed points, ensuring that measurements remain reliable and reproducible long after scene processing ends.

50. (B) I, III, and IV
Rough sketches must be drawn before evidence collection to preserve spatial relationships. Crime scene notes should be written in permanent ink to prevent unauthorized alterations or erasings. Finished sketches are drafted to scale using professional tools or CAD software. However, 3D laser scanning supplements but never completely replaces standard digital photography protocols.

51. (A) A certificate verifying the proper operation of the electronic device
Admissibility of digital photographic evidence requires establishing foundational legal authenticity and technological reliability. Jurisdictions often mandate a formal verification certificate or witness testimony demonstrating that the digital camera equipment and recording devices functioned properly, operated without technical defects, and produced accurate, untampered digital images representing the original scene conditions.

52. (C) To ensure measurements, locations, and details are consistent across all records
Cross-verifying notes, photographs, and sketches prior to scene release ensures absolute factual alignment and internal consistency among documentation formats. Discrepancies between evidence descriptions, frame logs, or dimensional measurements can undermine investigative credibility during court cross-examination. Systematic cross-checking guarantees a coherent, legally defensible, and comprehensive record of the entire scene.

53. (A) Using a long camera exposure time on a tripod
Luminol reactions produce chemiluminescence, emitting faint blue light in pitch-dark environments. Capturing this low-intensity fluorescence requires mounting the camera securely on a stable tripod to eliminate camera movement and selecting a long shutter exposure duration, allowing sufficient light to enter the sensor to yield clear, visible bloodstain images.

54. (D) Use a polarizing filter and angle the camera slightly
Photographing evidence on highly reflective surfaces like mirrors presents severe glare and unwanted camera reflection challenges. Investigators prevent reflections by angling the camera slightly off orthogonal alignment rather than shooting directly head-on. Attaching a linear or circular polarizing lens filter further neutralizes specular reflections and glares, ensuring crisp fingerprint detail.

NODIA

55. (A) P-2, Q-3, R-4, S-1
A 50mm fixed focal length lens closely mirrors the natural field of perspective of human vision. Macro lenses capture extreme close-ups of trace evidence at 1:1 magnification ratios. Wide-angle lenses assist in capturing confined indoor spaces. Ring flashes attach directly around lens elements, providing uniform, shadowless illumination for detailed close-ups.

56. (C) Barrel distortion
Barrel distortion is an optical aberration commonly associated with short focal length wide-angle lenses. It causes straight, parallel lines near the periphery of the image frame to curve outwards, resembling the shape of a wooden barrel. Recognizing and minimizing

barrel distortion is critical in forensic imaging to maintain rectilinear structural accuracy.

57. (D) As a gap in the wall line with a curved swing line
In standardized architectural and forensic drafting conventions, doors are represented within structural wall boundaries as an open gap accompanied by a curved arc or swing line. This specific symbol indicates both the presence of the doorway opening and the directional arc along which the door opens, establishing environmental orientation.

58. (A) The smell of an accelerant at an arson scene
Transient evidence consists of delicate physical signs or environmental indicators that evaporate, dissipate, degradation, or change rapidly over short time intervals. Volatile chemical odours, such as petroleum accelerants at arson scenes, represent classic transient evidence, requiring immediate sensory detection, documentation, and air sampling before atmospheric diffusion completely dissipates the volatile compounds.

59. (B) Cover fragile evidence to protect it, documenting as protection is applied
When sudden adverse weather threatens outdoor crime scene evidence, immediate protective intervention is required. Investigators must rapidly cover delicate physical items, such as biological stains or trace materials, using tarps or protective covers. Crucially, documenting evidence locations and environmental conditions as protective measures are deployed ensures evidentiary preservation without halting documentation.

60. (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
When capturing forensic close-up photographs, placing the scale on the identical plane as the evidence item is mandatory. If the scale rests on a different depth plane, focal distances vary, creating perspective distortion. This spatial displacement renders scale ratios inaccurate, preventing valid 1:1 physical comparisons and true dimensional evaluations.

61. (A) Milligrams per decilitre (mg/dL)
In forensic toxicology documentation, Blood Alcohol Concentration (BAC) is standardly expressed as milligrams of ethyl alcohol per decilitre of blood (mg/dL), or as a percentage equivalent representing grams per hundred millilitres. Standardized concentration units ensure clear legal interpretation, consistent medical reporting, and accurate comparison against statutory driving limit thresholds.

62. (C) A fully loaded parked delivery truck
Fixed reference points utilized in forensic spatial triangulation must be entirely permanent, immovable, and unalterable over extended durations. Structural walls, utility poles, and fire hydrants serve as valid landmarks. Conversely, motor vehicles, including loaded delivery trucks, are mobile structures that can be driven away, making them completely unacceptable reference points.

NODIA

63. (D) Dark, large crime scenes requiring illumination over multiple exposures
"Painting with light" is a specialized photographic technique utilized to illuminate extensive, dark indoor or outdoor crime scenes. With the camera secured on a tripod and the shutter set to a prolonged exposure duration, the photographer moves across the scene, systematically firing a handheld flash unit into unlit areas, producing uniformly lit images.

64. (C) "This stain proves the suspect committed the murder."
Narration during crime scene videography must remain strictly objective, factual, and descriptive, detailing locations, dates, times, and observable physical features. Injecting subjective conclusions, speculative opinions, or guilt assertions—such as declaring that a stain proves a suspect committed a crime—violates investigative impartiality and renders audio recordings subject to evidentiary challenge.

65. (A) I and II only
The triangulation method calculates evidence coordinates by measuring linear distances from two permanent reference points to the item, forming a geometric triangle. Contrary to misconceptions regarding outdoor limitations, triangulation is highly effective across both indoor and outdoor environments, provided stable, permanent reference landmarks are chosen for measurement baselines.

66. (B) 4 hours
Estimating post-mortem interval using body cooling relies on measuring core body temperature drop relative to ambient environment. Standard algor mortis models assume an average temperature loss rate of approximately 1.5°C per hour post-mortem. A temperature drop from normal body heat of 37.0°C down to 31.0°C represents a 6.0°C cooling, indicating roughly 4 hours.

67. (A) Take a series of overlapping photographs along the trail
Documenting an extensive bloodstain trail along a hallway requires taking a systematic series of overlapping photographs. Each consecutive photograph must overlap with the preceding image, capturing spatial continuity, individual droplet directions, pattern flow, and overall distribution while linking isolated bloodstains to fixed structural features along the complete path length.

68. (C) The range of distance that appears acceptably sharp and in focus
Depth of field in forensic photography defines the operational zone or distance range extending in front of and behind the primary focal point that appears acceptably sharp in the final image. Controlling depth of field via lens aperture adjustments ensures that both foreground evidence items and background environmental structures remain in clear focus.

69. (A) It exposes the camera sensor to dust, creating spots on future images
Changing camera lenses in dusty outdoor environments exposes the internal digital camera body and delicate image sensor to airborne particulates and debris. Dust settling on sensor glass creates persistent dark spots or optical blemishes across all subsequent crime scene photographs, degrading image quality and potentially obscuring faint physical evidence details.

70. (B) Enter and treat the victim → Secure the scene → Note the condition of doors/lights/smells → Establish a perimeter
First responders must prioritize life safety by entering to render medical aid to victims immediately. Once life safety is addressed, securing the scene, recording transient scene observations such as door status, light switches, or odours, and establishing a physical security perimeter prevent evidence contamination and preserve original environmental conditions.

71. (B) By laying a measuring tape exactly between two fixed reference points
A transecting baseline mapping system in large outdoor scenes requires laying a long measuring tape tightly between two established, permanent reference points. This stretched measuring tape serves as a known directional axis from which perpendicular ninety-degree measurements are taken to locate dispersed physical evidence items accurately throughout the scene area.

72. (C) Bullet trajectory documentation
Bullet trajectory documentation utilizes visual physical aids such as trajectory rods, stringing lines, alignment lasers, or 3D laser scanners to reconstruct the flight path of a projectile. By measuring impact angles, entry holes, and intermediate penetration points, forensic examiners establish spatial origins and shooter positions during crime scene analysis.

73. (D) .PDF
Finalizing CAD-generated crime scene sketches for formal reporting and judicial submission requires converting raw vector files into Portable Document Format (.PDF). Converting sketches to locked .PDF documents preserves graphical layout, scale proportions, embedded fonts, and vector elements while preventing unauthorized editing or accidental alteration of original court-ready diagrams.

74. (A) 6 (Four corners plus front and back)
Completely documenting the exterior of a vehicle involved in a crime requires a minimum of six overall photographs. Photographers must capture straight-on views of the front and rear ends, alongside four diagonal corner photographs. This systematic series ensures full 360-degree coverage, capturing all side panels, license plates, glass, and pre-existing damage.

75. (B) I, III, and IV
Hardware write-blockers preserve drive integrity by preventing data modification during extraction. Cryptographic hash algorithms verify exact file integrity over time. Digitally enhancing photographs for courtroom presentation mandates detailed documentation logs detailing every adjustment step. Crucially, non-destructive

Downloaded from www.pdf.tube

editing or contrast adjustment on copy files leaves original primary files untouched.

76. (B) "A red/brown stain."
Crime scene notes must strictly adhere to objective physical descriptions, avoiding unverified assumptions or scientific conclusions prior to laboratory testing. Describing an unconfirmed fluid marking as "a red/brown stain" accurately documents visible physical traits without prematurely declaring the material to be human blood, preserving objective documentation standards during initial investigation.

77. (A) Perspective distortion
Perspective distortion occurs when the camera sensor plane is not aligned parallel to the surface plane of the evidence item. Tilting the camera creates keystoning effects and false dimensional proportions. Ensuring parallel sensor alignment prevents scale distortion, preserving accurate structural shapes and permitting valid forensic comparison against reference standards.

78. (C) The top of the head and the center of the heels
When mapping the location of a deceased body on a crime scene sketch, measurements are conventionally taken from fixed environmental reference points to two distinct anatomical positions: the top of the head and the center of the heels. These reference points fix body alignment, orientation, and posture precisely within the scene floor plan.

79. (D) Lower video resolution lacks the high detail required for close-up forensic analysis
While videography offers continuous visual walkthroughs and spatial context across crime scenes, standard video resolution remains lower than high-resolution still photography. Detailed analysis of micro trace evidence, fingerprint minutiae, or fine tool marks requires high-pixel density and sharp optical resolution, making still photography essential and irreplaceable for detailed forensic examination.

80. (A) P-3, Q-2, R-1, S-4
Still photography captures high-resolution, static representations of evidence. Videography provides smooth, real-time visual walkthroughs of overall layouts. Rough sketches depict exact spatial relationships while removing visual clutter. 3D laser scanning generates detailed spatial measurements to create immersive, highly accurate virtual models of entire crime scenes for detailed analysis.

81. (B) The photograph remains valid if the scale unit is clearly visible and standard
Utilizing an inch scale rather than a metric centimeter scale does not invalidate photographic evidence in legal proceedings. As long as the scale is clearly visible, clearly labeled with standard measurement units, and positioned on the same plane as the object, accurate dimensional calibration and forensic size evaluation remain entirely valid.

82. (D) Mislabeling the case number on the photographic log
Administrative errors in forensic documentation involve mistakes made in recording operational metadata, identifiers, or administrative references rather than physical methodology. Mislabeling a case identification number on a photographic log represents a classic administrative error, compromising tracking accuracy, chain of custody links, and record correlation across investigative files.

83. (A) 1:2
Magnification ratio expresses the proportion between the size of an object's projected image on the camera sensor and its actual physical size. Calculating magnification involves dividing sensor image size by real object size. Here, a five-millimetre image on the sensor divided by a ten-millimetre physical length yields a magnification ratio of 1:2.

NODIA

84. (C) The exact location and type of the knot
Before cutting down a hanging victim, investigators must thoroughly document and photograph the exact placement and structural configuration of the ligature knot. Preserving knot morphology and location provides critical forensic clues regarding whether the hanging was self-inflicted or involved homicidal intervention, while allowing subsequent laboratory examination of knot construction techniques.

85. (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
The photographic log forms an integral component of chain of custody documentation for digital visual evidence. By systematically logging

operator identity, camera hardware, timestamp data, location, and technical exposure settings, the photographic log provides continuous accountability, verifying image authenticity, origin, and uncompromised evidentiary integrity from scene capture through judicial presentation.

86. (D) By using numbers or letters corresponding to a legend
In a rough crime scene sketch, evidence locations are systematically designated using distinct numbers or letters placed directly on the layout diagram. These alphanumeric markers correspond directly to an accompanying legend that details descriptive item information, keeping the primary sketch uncluttered, readable, and precisely cross-referenced to physical evidence logs.

87. (B) Aligning the sketch with cardinal directions, indicating magnetic North
Orientation in crime scene sketching refers to aligning the drawing with cardinal geographical directions. Drawing an explicit directional compass arrow pointing toward magnetic North establishes physical orientation. This geographic alignment allows reviewers, investigators, and court personnel to correctly relate sketch layouts to real-world directions, maps, and surrounding architectural structures.

88. (B) II and III only
Depth of field expands as the physical distance between the camera and subject increases. Conversely, using wider lens apertures (represented by smaller f-stop numbers) narrows the depth of field. Shorter focal lengths increase depth of field, whereas longer focal lengths decrease it, rendering statement one incorrect and confirming the combination.

89. (D) Focus stacking
Focus stacking is a specialized digital imaging technique used to overcome limited depth of field in extreme close-up or macro photography. Photographers capture a sequential series of images at varying focal planes across the evidence item and merge them using software, producing a single final image with complete, extended depth sharpness.

90. (B) I, II, III, IV
Standard crime scene documentation follows a strict logical workflow. Processing begins with an initial walkthrough to assess scene boundaries and plan strategies without altering evidence. Comprehensive photography follows, capturing overall, mid-range, and close-up views. Next, investigators prepare a rough sketch with precise measurements. Finally, physical evidence is systematically collected, packaged, and documented.

www.nodia.in

Click Here to Buy book on Amazon

CHAPTER 07

Collectio, Preservation, Packaging and Chain of Custody

1. Which foundational principle of forensic science necessitates the meticulous collection, preservation, and packaging of trace evidence at a crime scene?
(A) Principle of Individuality
(B) Locard's Exchange Principle
(C) Principle of Comparison
(D) Principle of Analysis

2. When a first responder arrives at an outdoor crime scene where it has just started to rain, which type of evidence must be collected first?
(A) Fingerprints on indoor door handles
(B) Heavy weapons left under a covered porch
(C) Document evidence stored inside a safe
(D) Fragile and transient evidence like tyre marks in mud or bloodstains on the ground

3. Which of the following is an example of transient evidence that must be documented immediately upon arrival at a crime scene?
(A) The smell of unburned gasoline in a room
(B) The physical dimensions of a room
(C) A handwritten suicide note
(D) A bullet casing ejected on the floor

4. Match List I with List II.
List I: (Evidence)
P. Arson debris
Q. Wet bloodstained shirt
R. Small glass fragments
S. Liquid blood for toxicology
List II: (Primary packaging container)
1. Paper bag
2. Clean glass vial with airtight cap
3. Nylon bag or airtight metal can
4. Druggist fold / Bindle
(A) P-3, Q-1, R-4, S-2
(B) P-1, Q-3, R-2, S-4
(C) P-3, Q-4, R-1, S-2
(D) P-2, Q-1, R-3, S-4

5. In forensic evidence collection, what is the purpose of collecting a substrate control?
(A) To ensure background material does not interfere with testing
(B) To provide a known reference sample of the suspect's DNA for comparison
(C) To calibrate laboratory instruments before analyzing the primary exhibit
(D) To serve as a secondary backup sample in case the main evidence is lost

6. Why are elimination fingerprints routinely collected from the inhabitants of a burglarized home?
(A) To initiate criminal charges against inhabitants if they provide false details about the burglary
(B) To maintain a permanent registry of all local citizens within the national forensic database
(C) To serve as negative substrate controls during chemical latent print development procedures
(D) To separate residents' latent prints from those of the perpetrator

7. Given below are two statements:
Statement I: Wet bloodstains should be packaged immediately in airtight plastic bags to prevent any leakage during transport.
Statement II: Biological evidence sealed in airtight plastic bags while wet is highly susceptible to mold growth and DNA degradation.
In the light of the above statements, choose the correct answer from the options given below:
(A) Both Statement I and Statement II are correct
(B) Both Statement I and Statement II are incorrect
(C) Statement I is correct but Statement II is incorrect
(D) Statement I is incorrect but Statement II is correct

8. Arrange the following fundamental steps of processing a crime scene in the correct chronological order:

NODIA

1. Photographing the scene and evidence
2. Securing and cordoning off the scene
3. Collecting, packaging, and sealing evidence
4. Preparing a rough sketch of the scene

(A) 2, 1, 4, 3
(B) 2, 4, 1, 3
(C) 1, 2, 3, 4
(D) 4, 1, 2, 3

9. The double-swab technique is frequently used to collect touch DNA or dried bodily fluids from non-porous surfaces. What does this technique involve?
(A) Swabbing the designated stain area using two dry cotton swabs simultaneously to maximize physical friction
(B) Swabbing the evidence stain with a completely dry swab first, followed by a swab soaked in ethanol
(C) Using one swab for collecting evidence and a second swab on an unrelated surface in the same room
(D) Swabbing with a sterile water-moistened swab followed by a dry swab

10. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Liquid blood samples collected for DNA profiling should be collected in vials containing EDTA.
Reason (R): EDTA inhibits the activity of enzymes that degrade DNA and prevents the blood from clotting.
In the light of the above statements, choose the correct answer from the options given below:
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

11. Consider the following statements regarding hair evidence collection:
I. Plucking hairs is preferred over cutting them to ensure the root is collected.
II. The root of the hair is essential for successful nuclear DNA profiling.
III. Standard head hair samples generally require collecting only 2 to 3 hairs.
Which of the above statements are correct?
(A) I and II
(B) II and III
(C) I and III
(D) I, II, and III

12. In Indian autopsy practice, what is the standard and most widely used preservative for storing viscera in general cases of suspected poisoning?
(A) A ten percent buffered solution of Formaldehyde (Formalin)
(B) Saturated sodium chloride solution
(C) An aqueous ten percent solution of Sodium Hydroxide
(D) A diluted aqueous Potassium Permanganate solution

13. Which of the following statements best explains why Dental Stone is preferred over Plaster of Paris (PoP) for casting footwear impressions?
(A) Dental Stone provides greater strength and finer detail than PoP.
(B) Dental Stone sets at a significantly faster rate, fully hardening within two minutes.
(C) Dental Stone requires specialized liquid additives and complex mixing tools not needed for PoP.
(D) Dental Stone forms an extremely porous structure that allows rapid moisture escape from the cast.

14. After lifting a latent fingerprint from a crime scene using specialized lifting tape, what must the investigator do next to preserve it?
(A) Fold the lifting tape tightly onto itself so that the adhesive surface is completely sealed shut
(B) Submerge the lifting tape in a beaker filled with distilled water to stop the adhesive layer from drying
(C) Mount the tape adhesive-side down on a contrasting backing card
(D) Apply an additional thick coat of fingerprint powder directly onto the adhesive layer of the tape

15. Which of the following packaging materials is considered inappropriate and risky for packaging a seized, powered-on mobile phone?
(A) A specialized Faraday bag
(B) A static-shielding protective bag
(C) A multi-layered aluminium foil wrapping
(D) A paper envelope

16. Match List I with List II.
List I: (Anatomical specimen)
P. Stomach and its contents

Downloaded from www.pdf.tube

Q. Blood
R. Brain tissue
S. Liver

List II: (Forensic toxicological requirement/ characteristic)

1. Best for detecting inhaled poisons like Carbon Monoxide
2. Primary organ for preserving in volatile poison cases like organophosphates
3. Indicates unabsorbed poison and route of administration
4. Major site of drug metabolism and accumulation

(A) P-3, Q-1, R-2, S-4
(B) P-1, Q-3, R-4, S-2
(C) P-3, Q-4, R-1, S-2
(D) P-4, Q-2, R-1, S-3

17. Which of the following containers must NOT be used to package debris collected from a suspected arson scene?
(A) Unused clean metal paint cans with tightly fitting lids
(B) Standard paper bags
(C) Specialized non-porous nylon evidence bags
(D) Heavy-duty glass jars equipped with airtight sealing lids

18. When collecting standard or reference soil samples from an alibi location to compare against soil found on a suspect's shoe, from what depth should the sample primarily be taken?
(A) 1 to 2 feet below the surface
(B) Exactly 10 inches below the surface
(C) From a randomly dug deep trench
(D) Only from the top surface layer

19. Lighting conditions, the position of furniture, and the status of windows and doors (locked or unlocked) at a crime scene are examples of which type of evidence?
(A) Conditional evidence
(B) Physical trace evidence
(C) Structural pattern evidence
(D) Contact transfer evidence

20. Consider the following statements regarding the handling of firearms at a crime scene:
I. A firearm should be picked up by inserting a pencil or pen into the barrel to preserve fingerprints on the grip.
II. The exact position of the hammer and safety catch should be recorded before moving the weapon.
III. Unless it poses an immediate safety hazard, a firearm should not be unloaded before its state is fully documented.
IV. The make, model, and serial number of the firearm must be recorded in the seizure memo.

Which of the above statements is/are incorrect?
(A) I only
(B) II and III
(C) III and IV
(D) I and IV

NODIA

21. What is the primary legal and procedural purpose of maintaining a continuous chain of custody for physical evidence?
(A) To prove the evidence in court is unchanged from collection and untampered with
(B) To document and track all administrative and financial expenditure incurred during laboratory analysis
(C) To guarantee that seized evidence is safely returned to its legal owner right after testing ends
(D) To provide accredited media representatives with access to monitor high-profile investigation progress

22. Select the correct order of actions for safely collecting and packaging charred documents found in a fireplace.
(A) Pick up the charred fragments using metal tweezers → place inside a paper envelope → seal and carry in a pocket
(B) Spray the delicate burnt paper heavily with water → fold tightly → package inside a sealed plastic bag
(C) Vacuum all ash fragments → place into a standard paper bag → crush down firmly to conserve container space → seal
(D) Slide rigid card under document → place in rigid box → pad with cotton → seal

23. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Bloodstained clothing recovered from a victim should be thoroughly air-dried at room temperature before being packaged in paper bags.
Reason (R): Packaging wet bloodstained clothing in airtight containers promotes bacterial and fungal growth, which rapidly degrades DNA evidence.
In the light of the above statements, choose the

correct answer from the options given below:
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

24. Which of the following pairs regarding tool mark collection is incorrect?
(A) Moveable object with tool mark → Collect and transport the entire object to the lab
(B) Immovable object with tool mark → Cast the impression using silicone rubber (Mikrosil)
(C) Suspect tool recovered → Insert the tool into the mark to see if it fits perfectly
(D) Photographing tool marks → Must include a scale and be taken with oblique lighting

25. To ensure all layers of a paint transfer are collected for forensic comparison, the investigator should ideally:
(A) Swab the affected exterior paint surface using a sterile cotton swab thoroughly soaked in distilled water
(B) Peel away only the uppermost clear coat layer of paint using strong commercial adhesive tape strips
(C) Dissolve the paint layers on the suspect vehicle using acetone solvent and collect the resulting liquid
(D) Scrape paint down to bare substrate using a clean blade

26. Which chemical preservative is typically added to liquid blood samples collected from a living subject for the estimation of blood alcohol concentration (BAC)?
(A) Sodium fluoride and potassium oxalate
(B) Ethylenediaminetetraacetic acid (EDTA) formulation
(C) Saturated concentration of sodium chloride
(D) Standard sodium heparin anticoagulant

27. What is the most appropriate method to collect a dry, crusty semen stain found on a large, removable object such as a bedsheet?
(A) Scrape the stain off the bedsheet using a metal spatula into a plastic bag
(B) Package the entire bedsheet in a paper bag and submit it to the laboratory
(C) Swab the stain with a completely dry swab
(D) Cut out the stained area, discard the rest of the sheet, and pack the cutting in plastic

28. Given below are two statements:
Statement I: Loose fibers on a victim's clothing can be effectively collected using the forensic tape-lifting method.
Statement II: Once lifted, the adhesive tape containing the fibers should be immediately placed on a clear acetate sheet or clean glass slide.
In the light of the above statements, choose the correct answer from the options given below:
(A) Both Statement I and Statement II are correct
(B) Both Statement I and Statement II are incorrect
(C) Statement I is correct but Statement II is incorrect
(D) Statement I is incorrect but Statement II is correct

29. Consider the following statements about glass evidence:
I. Glass fragments collected from different locations (e.g., inside the car vs. outside the car) must be packaged in the same container to save space.
II. Glass pieces should be packed in rigid, crush-proof containers with adequate padding to prevent further breakage.
III. Radial and concentric fractures on broken glass can help determine the direction of the applied force.
Which of the above statements are correct?
(A) I and II
(B) II and III
(C) I and III
(D) I, II, and III

30. During a medico-legal autopsy in India, what is the standard recommended quantity of blood to be preserved for toxicological analysis?
(A) 1 to 2 ml
(B) 10 to 20 ml
(C) 100 to 150 ml
(D) 500 ml

31. What is the primary forensic use of a "druggist fold" (bindle)?
(A) To store and transport large fluid volumes of liquid whole blood safely to the laboratory
(B) To act as a protective electrostatic cover for delicate seized computer hard drives
(C) To safely contain and preserve highly volatile hydrocarbon arson residues during transit
(D) To securely package small trace evidence

Click Here to Buy book on Flipkart

without leakage

32. Arrange the sequence of steps for collecting a dried bloodstain using the double-swab technique in correct chronological order:
1. Air-dry both swabs completely
2. Moisten the first swab with sterile distilled water
3. Swab the stain with the moistened swab
4. Swab the same area with a second dry swab

(A) 2, 3, 4, 1
(B) 3, 2, 4, 1
(C) 2, 4, 3, 1
(D) 1, 2, 3, 4

33. Match List I with List II.
List I: (Physiological fluid/stain)
P. Saliva stains
Q. Semen stains
R. Bloodstains
S. Perspiration/Sweat stains
List II: (Presumptive screening target)
1. Acid Phosphatase
2. Amylase
3. DNA from epithelial cells
4. Hemoglobin (peroxidase-like activity)

(A) P-2, Q-1, R-4, S-3
(B) P-1, Q-2, R-3, S-4
(C) P-2, Q-3, R-1, S-4
(D) P-3, Q-1, R-4, S-2

34. When processing a post-blast scene for explosive residues, which action must NOT be taken?
(A) Systematically collecting surface soil samples directly from the epicenter of the blast crater
(B) Packaging all recovered suspected explosive residues inside clean, airtight metal containers
(C) Using clean, thoroughly uncontaminated metal scrapers to harvest residues from hard surfaces
(D) Combining residues from multiple locations into one single evidence bag

35. What is the specific forensic purpose of placing a seized mobile phone inside a Faraday bag?
(A) To block network signals and prevent remote data wiping or modification
(B) To prevent the device's internal battery from discharging and draining completely prior to analysis
(C) To cushion the mobile device against physical shocks, accidental drops, and screen fractures during transit
(D) To facilitate the chemical development of latent fingerprints on the phone housing using cyanoacrylate fumes

36. In the context of evidence collection, what constitutes a "reference sample"?
(A) An unidentified evidence sample of unknown origin recovered directly from the primary crime scene
(B) The specialized chemical reagent applied to suspect stains to test for the presence of human blood
(C) Material of known origin collected for comparative forensic analysis
(D) A duplicate evidentiary sample forwarded to an independent secondary laboratory to verify initial test results

37. Consider the following statements regarding the forwarding of exhibits to the Forensic Science Laboratory (FSL):
I. Exhibits are accompanied by a completed Forwarding Note signed by the competent authority.
II. A separate road certificate (RC) is not necessary when exhibits are carried by a special messenger.
III. The specimen seal impression used to seal the exhibits must be sent to the FSL for verification.
IV. A copy of the First Information Report (FIR) must accompany the exhibits.

Which of the above statements is/are incorrect?
(A) I and III
(B) II only
(C) III and IV
(D) I, II, and IV

38. When investigating a forced entry, an investigator finds a suspected crowbar near a door with pry marks. The investigator should:
(A) Immediately insert the tip of the crowbar into the pry marks to test whether the weapon fits precisely
(B) Swab the pry mark impressions to check if trace metal residues from the crowbar transferred onto the door surface
(C) Leave both the tool and the impression untouched without taking casts, relying solely on photographic records
(D) Measure the tool, cast the marks, and package them separately

Downloaded from www.pdf.tube

39. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): The original specimen seal impression must be retained safely and a copy forwarded to the forensic laboratory along with the exhibit.
Reason (R): The forensic laboratory compares the seal on the exhibit with the specimen seal to ensure the parcel was not tampered with during transit.
In the light of the above statements, choose the correct answer from the options given below:
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

40. According to standard procedure, who typically keeps custody of the original brass or metal specimen seal after sealing exhibits at a crime scene, to maintain the integrity of the process?
(A) The designated Investigating Officer responsible for drafting the official seizure memo
(B) The primary accused or suspect named in the First Information Report
(C) The independent witness in whose presence sealing occurred
(D) The judicial magistrate presiding over the suspect's initial court remand proceedings

41. Which of the following details is NOT typically required to be documented on a standard Chain of Custody form?
(A) A detailed physical description and inventory classification of the seized evidence
(B) The full signature and printed name of each handler taking custody of the evidence
(C) The precise calendar date and official time recorded for each evidence transfer
(D) The specific lab testing methods used for analysis

42. Why are specialized nylon bags or glass jars preferred over standard polyethylene plastic bags for packaging volatile arson debris?
(A) Hydrocarbon vapours easily permeate polyethylene bags, losing evidence
(B) Standard polyethylene bags are chemically unstable near charred debris and may spontaneously catch fire
(C) Polyethylene plastic undergoes rapid exothermic chemical reactions when contacting hot charred wood particles
(D) Specialized nylon bags are far less expensive to manufacture and much more widely stocked in police stations

43. Select the correct sequence representing the standard chain of custody movement for physical evidence collected during a police investigation.
(A) Property Room (Malkhana) → Investigating Officer → Crime Scene → Forensic Science Laboratory
(B) Crime Scene → Investigating Officer → Police Station Property Room (Malkhana) → Forensic Science Laboratory
(C) Forensic Science Laboratory → Police Station Property Room (Malkhana) → Investigating Officer → Crime Scene
(D) Police Station Property Room (Malkhana) → Forensic Science Laboratory → Investigating Officer → Crime Scene

44. Identify the odd one out among the following items regarding their appropriateness for biological evidence packaging.
(A) Heavy-duty breathable brown paper bags
(B) Zip-lock plastic bags
(C) Ventilated rigid cardboard storage boxes
(D) Standard heavy-stock paper manila envelopes

45. Match List I with List II.
List I: (Toxicological condition)
P. Suspected Organophosphorus poisoning (Viscera)
Q. Suspected Carbolic acid (Phenol) poisoning (Viscera)
R. Blood sample for alcohol estimation
S. Blood sample for DNA profiling
List II: (Recommended preservative)
1. Saturated sodium chloride solution
2. Saturated sodium chloride solution (avoiding rectified spirit)
3. Sodium Fluoride and Potassium Oxalate
4. EDTA
(A) P-1, Q-2, R-3, S-4
(B) P-2, Q-1, R-4, S-3
(C) P-1, Q-2, R-4, S-3
(D) P-2, Q-1, R-3, S-4

46. Consider the following statements regarding the general principles of packaging evidence:
I. Each piece of evidence must be packaged

NODIA

separately to avoid cross-contamination.
II. Wet biological exhibits should be stored at room temperature in airtight containers for long-term preservation.
III. Breathable containers like paper bags are used for biologicals to prevent putrefaction and mold.
Which of the above statements are correct?
(A) I and II
(B) II and III
(C) I and III
(D) I, II, and III

47. Under standard police procedure, exhibits destined for the Forensic Science Laboratory are formally forwarded through the office of which authority?
(A) The Office of the District Magistrate of the concerned district
(B) The Station House Officer of the local police station directly
(C) The Inspector General of Police assigned to the regional zone
(D) The Superintendent of Police or Chief Medical Officer

48. What should an Investigating Officer NOT do when recovering an embedded bullet from a wooden wall?
(A) Carefully cut away and remove the surrounding wooden frame to free the embedded bullet safely
(B) Utilize a soft rubber-tipped instrument or plastic tool to gently extract the bullet if it is loose
(C) Dig out the bullet using metal forceps or pliers
(D) Wrap the extracted bullet securely in soft cotton wool before placing it into a rigid pillbox

49. Given below are two statements:
Statement I: If indented writings are suspected on a writing pad, the investigator should lightly rub a pencil over the top sheet to make the indentations visible before seizing it.
Statement II: Questioned documents should always be kept flat and handled with forceps or gloved hands to avoid depositing latent prints.
In the light of the above statements, choose the correct answer from the options given below:
(A) Both Statement I and Statement II are correct
(B) Both Statement I and Statement II are incorrect
(C) Statement I is correct but Statement II is incorrect
(D) Statement I is incorrect but Statement II is correct

50. How must a loaded revolver recovered from a crime scene be prepared for safe transport to the laboratory?
(A) Engage the safety mechanism and transport the revolver in its fully loaded state to maintain physical evidence
(B) Discharge the revolver into a soft backstop at the scene to empty all chambers prior to laboratory submission
(C) Submerge the entire revolver in mineral oil inside a sealed container to prevent rust formation during transit
(D) Unload the weapon while logging cylinder and cartridge positions, then package securely

51. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): At a homicide scene, trace evidence like loose hairs and fibres on the victim's body should ideally be collected before the body is moved for autopsy.
Reason (R): Trace evidence is highly transient and easily dislodged, lost, or contaminated during the bagging and transport of the body.
In the light of the above statements, choose the correct answer from the options given below:
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

52. When packaging viscera in glass jars with saturated saline solution for toxicological analysis, how much space in the jar should be left empty to accommodate gas formation during putrefaction?
(A) No space at all; the container must be filled completely to the brim
(B) A small air space equal to one-tenth (1/10th) of the container's volume
(C) About one-third of the volume
(D) An expansive space of over three-quarters (3/4ths) of the container's volume

Click Here to Buy book on Amazon

53. In an arson investigation, a burnt section of carpet containing suspected accelerants is collected. What would be the correct substrate control in this scenario?
(A) Unburnt carpet from an unaffected area of the same room
(B) A liquid accelerant sample recovered from a container stored in the suspect's garage
(C) A sample of unburnt flooring material taken from a completely different room like the kitchen
(D) A reference sample of topsoil collected directly outside the exterior walls of the building

54. Which of the following pairs regarding biological fluid preservatives is incorrect?
(A) Blood for grouping → No preservative, allowed to clot
(B) Urine for toxicological analysis → Sodium Azide or Sodium Fluoride
(C) Saliva swab → Air dried, no chemical preservative added
(D) Blood for DNA analysis → Formalin

55. Consider the following statements regarding the property room (Malkhana) register in a police station:
I. The Malkhana Register is officially designated as Register No. 19 in standard police regulations.
II. It is used exclusively to record the attendance of police personnel.
III. It tracks the inward receipt, outward movement to the forensic science laboratory, and final disposal of case properties.
IV. The signature of the person depositing or removing the evidence must be recorded.
Which of the above statements are correct?
(A) I, II, and III
(B) II, III, and IV
(C) I, III, and IV
(D) I and IV only

56. Which of the following biological samples should NEVER be frozen because freezing causes cellular lysis (rupture of cells) which can interfere with certain analyses?
(A) Extracted DNA samples in buffer
(B) Dried bloodstains on paper substrates
(C) Tubes of liquid whole blood
(D) Frozen deep muscle tissue specimens

57. Which of the following is an unacceptable and destructive method to dry wet bloodstained clothing at a crime scene?
(A) Air-drying at room temperature
(B) Hanging the clothes on a clean plastic hanger in a well-ventilated room
(C) Placing the clothing in a designated forensic drying cabinet
(D) Using a hair dryer on high heat to speed up the drying process

58. What is the most appropriate method for recovering potential suspect saliva from a bite mark on a living victim's skin?
(A) Using the double-swab technique on the bite mark
(B) Carefully scraping the skin surface around the bite mark using a sterile scalpel blade
(C) Applying clear adhesive fingerprint lifting tape firmly over the bite mark surface
(D) Applying a liquid chemical presumptive testing reagent directly onto the victim's skin

NODIA

59. When collecting a standard reference hair sample from a suspect, what is the generally accepted minimum number of full-length head hairs that should be plucked to represent natural variation?
(A) 1 to 5 hairs
(B) 10 to 15 hairs
(C) 50 to 100 hairs
(D) 500 to 1000 hairs

60. If a desktop computer is found completely powered off at a crime scene during a cybercrime investigation, the first responder should:
(A) Power on the system immediately to inspect whether criminal evidence is displayed on the monitor
(B) Unplug the power cable from the back and seize the PC
(C) Attempt to boot up the operating system by entering potential passwords provided by the suspect
(D) Plug in an external USB drive to copy relevant files before performing a standard system shutdown

61. Given below are two statements:
Statement I: Investigators should engrave their initials directly onto the primer or the base of a fired cartridge case.
Statement II: Fired bullets should be marked on the bearing surface (the sides with rifling marks)

to ensure visibility.
In the light of the above statements, choose the correct answer from the options given below:
(A) Both Statement I and Statement II are correct
(B) Both Statement I and Statement II are incorrect
(C) Statement I is correct but Statement II is incorrect
(D) Statement I is incorrect but Statement II is correct

62. To ensure that an evidence parcel has not been surreptitiously opened and resealed, where should the signatures of the investigating officer and witnesses ideally be placed?
(A) Recorded exclusively on the Chain of Custody form without writing on the outer parcel
(B) Written at the bottom of the parcel and completely covered with clear adhesive tape
(C) Across the seal flap, bridging the label and wrapper
(D) Placed on a paper slip inserted directly inside the sealed envelope alongside the evidence

63. In a hit-and-run case, a suspect vehicle is located with fresh damage. Where should the investigator collect the standard/reference paint sample from the vehicle?
(A) Directly from the central impact point of the deeply scraped and damaged metal area
(B) From an interior plastic component such as the vehicle's front dashboard panel
(C) Exclusively from the front bumper surface, regardless of the actual impact location
(D) From an undamaged area near the damaged site

64. Consider the following statements regarding the handling of digital evidence:
I. Cell phones should be immediately isolated from networks (e.g., placed in airplane mode or a Faraday bag) to prevent remote wiping.
II. It is no longer a best practice to blindly rip the battery out of all mobile devices, as this may trigger security locks or cause data loss.
III. Any removed SIM cards or memory cards must be documented, seized, and labeled as separate exhibits.
Which of the above statements are correct?
(A) I and II
(B) II and III
(C) I and III
(D) I, II, and III

65. When casting a continuous tyre mark at a crime scene, what is the recommended minimum length of the impression to cast to ensure at least one full rotation of the tyre is captured?
(A) 6 inches
(B) 1 foot
(C) 3 to 4 feet (or the full circumference of a standard tyre)
(D) The entire length of the skid mark, even if it is 100 feet long

66. How should soil evidence collected from a crime scene NOT be packaged?
(A) Inside a thoroughly cleaned and dried glass vial with an airtight cap
(B) Inside a sturdy cardboard pillbox securely taped along all outer edges
(C) Inside a tightly sealed rigid plastic container, provided the soil is completely dry
(D) In a paper envelope where particles can leak out

67. Which of the following is the correct procedure for tape-lifting trace evidence (like micro-fibres or pollen) from a car seat?
(A) Pat tape over the seat until tackiness is lost, then stick onto a clear backing card
(B) Press the adhesive tape onto the seat once, then fold it firmly in half so sticky surfaces touch
(C) Apply the tape to the seat surface, pull it off forcefully, and store it folded loosely in a paper bag
(D) Dust the entire car seat with black fingerprint powder first, then attempt to lift fibers using tape

68. In routine viscera collection for toxicological analysis in India, three primary wide-mouthed glass bottles are used. Which of the following anatomical items is NOT traditionally placed in one of these three primary bottles?
(A) Stomach, intestines and their contents
(B) Liver, spleen, and kidneys
(C) Brain tissue
(D) Blood and urine

69. If a death is suspected to be caused by an organophosphate poison, the brain tissue is separately preserved and sent to the laboratory primarily because:
(A) To measure cholinesterase enzyme activity

Downloaded from www.pdf.tube

inhibition
(B) Because the brain tissue selectively retains exceptionally high levels of blood alcohol
(C) Because central nervous system tissue is the sole organ retaining characteristic chemical odors
(D) Because organophosphate compounds cause immediate severe necrosis of hepatic and renal tissues

70. What is the best method for packaging a questioned document, such as a forged cheque, for submission to the laboratory?
(A) Fold it multiple times so it fits into a small standard envelope
(B) Staple it to the forwarding memo to prevent it from getting lost
(C) Seal it in an airtight plastic bag with a wet sponge to preserve ink moisture
(D) Place it flat and unfolded in a cellophane folder or heavy manila envelope

71. What is an accepted method for collecting a dried bloodstain situated on an immovable brick wall?
(A) Applying a high-temperature blowtorch directly to the wall to melt and collect the dried blood deposit
(B) Chip out the brick section, scrape the stain, or swab with a moist swab
(C) Coating the dried bloodstain with a layer of clear nail polish and peeling the dried film off the brick
(D) Spraying the entire brick surface with luminol reagent and taking photographs without harvesting physical samples

72. Which of the following is a classic example of "transient evidence"?
(A) A complete nuclear DNA profile successfully extracted from a skeletal bone sample
(B) Microscopic land and groove striation marks present on a recovered fired bullet
(C) Perfume or smoke odors in a closed room
(D) An impression of a footwear pattern permanently cast into cured concrete flooring

73. Given below are two statements:
Statement I: Paper bags are utilized for biological evidence because they allow the evidence to breathe, preventing moisture buildup.
Statement II: Plastic bags are always preferred over paper bags for the long-term storage of thoroughly dried bloodstains.
In the light of the above statements, choose the correct answer from the options given below:
(A) Both Statement I and Statement II are correct
(B) Both Statement I and Statement II are incorrect
(C) Statement I is correct but Statement II is incorrect
(D) Statement I is incorrect but Statement II is correct

74. Which of the following exhibits must strictly be maintained under refrigeration (2-8°C) if it cannot be transported to the laboratory immediately?
(A) Liquid blood samples for DNA testing
(B) Dried multi-layered paint chips collected from a hit-and-run collision scene
(C) Fired brass cartridge cases recovered near the victim's body
(D) Cured plaster of Paris or dental stone casts of footwear footprints

NODIA

75. In a burglary investigation, whose fingerprints are most routinely taken to serve as elimination prints?
(A) The full set of rolled reference fingerprints obtained from the primary suspect
(B) The fingerprints of lawful occupants and residents
(C) The ten-print finger impressions of all attending investigating officers exclusively
(D) The reference fingerprints collected from immediate neighbors living in adjacent houses

76. Which packaging material is strongly contraindicated for preserving debris from a suspected arson case due to its chemical composition and permeability?
(A) Specialized non-porous nylon evidence bags
(B) Polyethylene bags
(C) Airtight sealed glass Mason jars
(D) Clean, unused metal paint cans

77. If the chain of custody of a murder weapon is broken because an investigating officer took it home overnight without logging it, what is the primary legal consequence in court proceedings?
(A) The weapon's evidentiary value is severely compromised due to potential tampering
(B) The police officer who took the weapon home is automatically indicted as an accomplice to the murder

(C) The state forensic laboratory will unconditionally reject and refuse to conduct testing on the weapon
(D) The court is legally mandated to presume the defendant entirely innocent and dismiss all charges immediately

78. What is the most common and effective material used by forensic experts to cast toolmarks left on a wooden window frame?
(A) High-strength dental stone gypsum formulation
(B) Standard laboratory grade Plaster of Paris mixture
(C) Silicone rubber material (e.g., Mikrosil)
(D) Soft non-hardening oil-based modeling clay

79. Which of the following pairs regarding tissue preservation in forensic pathology is correct?
(A) Toxicological examination (general) → Preserved in 10% Formalin
(B) DNA extraction from tissue → Preserved in Rectified Spirit
(C) Viscera for corrosive acid poisoning → Preserved in 10% Formalin
(D) Histopathological examination → Preserved in 10% Formalin

80. How should an investigator collect dry soil adhering to the tread of a suspect's shoe?
(A) Vigorously brush all adhering dry soil off the shoe tread directly into a small paper envelope at the scene
(B) Thoroughly wash the shoe sole with distilled water and collect the resulting liquid muddy runoff into a vial
(C) Leave soil intact on the shoe, pack shoe in paper bag, send to lab
(D) Forcefully scrape all dried soil off the tread using a sharp metal knife into an airtight plastic bag

81. Which register at a police station is specifically designated for recording the entry and exit of case property (exhibits)?
(A) Register No. 4 (Village Crime Notebook)
(B) Register No. 8 (Absconders Register)
(C) Register No. 19 (Malkhana Register)
(D) Register No. 21 (Arrest Register)

82. Given below are two statements:
Statement I: Blood intended for standard serological blood grouping (ABO typing) is often collected in plain vials without anticoagulants to allow the serum to separate.
Statement II: Serum is the clear yellowish fluid that separates from blood upon clotting.
In the light of the above statements, choose the correct answer from the options given below:
(A) Both Statement I and Statement II are correct
(B) Both Statement I and Statement II are incorrect
(C) Statement I is correct but Statement II is incorrect
(D) Statement I is incorrect but Statement II is correct

83. When collecting glass shards from a broken window to determine the direction of force (using the 3R rule), what must the investigator ensure to mark on the collected fragments before removing them?
(A) Which surface faced inside and which faced outside
(B) The exact chemical formulation and elemental composition of the glass sheet
(C) The precise physical refractive index measurement of the glass fragment
(D) The original commercial manufacturer name and batch number of the glass

84. Which of the following represents the minimum essential information that must be present on an evidence label?
(A) Suspect's signed confession statement, Investigating Officer's signature, and date of interrogation
(B) Preliminary laboratory analysis results, registered FIR Number, and date of specimen collection
(C) FIR number, item description, seizure date/time, IO and witness signatures
(D) Victim's complete medical treatment history, item description, and Investigating Officer signature

85. What is a critical error an investigator can make when handling a suspect tool (e.g., a screwdriver) and a toolmark (e.g., a gouge on a door)?
(A) Inserting the tool into the mark to test for a match
(B) Taking close-up scale photographs of the toolmark impression prior to applying silicone casting material
(C) Packaging the suspect tool and the damaged wooden door section in completely separate evidence containers

Click Here to Buy book on Flipkart

(D) Applying liquid silicone rubber compound to produce a detailed three-dimensional cast of the toolmark

86. In cases of suspected poisoning by carbolic acid (phenol), which preservative is used for preserving the viscera?
(A) Pure commercial grade rectified spirit
(B) Ten percent neutral buffered formalin solution
(C) No chemical preservative solution is added
(D) Saturated sodium chloride solution

87. What is the standard accepted method for collecting gunshot residue (GSR) from the hands of a suspected shooter?
(A) Taking ten-print rolled ink fingerprints from both hands of the suspected shooter
(B) Dabbing hands with adhesive GSR stubs or swabbing with 5% nitric acid
(C) Washing the suspect's hands thoroughly with liquid soap and collecting the runoff water in a jar
(D) Instructing the suspect to vigorously rub both hands across a sheet of clean dry filter paper

88. Which of the following is the correct statement regarding the handling of a victim's bloodstained clothing?
(A) All items of clothing from the victim should be packed together in one bag to keep the case evidence consolidated.
(B) Clothing must be washed to reveal hidden cuts or tears before being sent to the FSL.
(C) Each item of clothing must be packaged in its own separate paper bag to prevent cross-contamination.
(D) Clothing should be packed tightly into small plastic containers to preserve the smell of the scene.

89. When swabbing a suspected bloodstain from a tile floor, the investigator also takes a swab from an unstained area of the same tile floor. What is this second swab called?
(A) A positive control
(B) An elimination swab
(C) An unknown specimen
(D) A substrate control

90. Which of the following containers is most appropriate for collecting and transporting viscera suspected of containing a volatile poison (like cyanide or alcohol)?
(A) A clean wide-mouthed glass jar with an airtight lid
(B) A thin permeable plastic evidence bag allowing gas exchange
(C) A heavy-duty corrugated cardboard storage box with sealed flaps
(D) A multi-folded paper druggist fold placed inside a brown paper envelope

NODIA
www.nodia.in

ANSWERS

1. (B) Locard's Exchange Principle
Locard's Exchange Principle states that whenever two objects come into contact with one another, there is always a cross-transfer of physical material. This core concept forms the foundational basis for forensic evidence collection, highlighting that a perpetrator will both bring materials to a crime scene and carry traces away from it during an incident.

2. (D) Fragile and transient evidence like tyre marks in mud or bloodstains on the ground
Environmental factors like rain, wind, or extreme temperatures can rapidly wash away, alter, or completely destroy delicate physical evidence located outdoors. First responders must prioritize capturing fragile and transient evidence, such as footprints, bloodstains on soil, and tire impressions, to ensure these crucial traces are permanently documented and preserved before natural weather conditions degrade them beyond recognition.

3. (A) The smell of unburned gasoline in a room
Transient evidence is temporary and highly susceptible to rapid change or dissipation over time. Odors, such as unburned gasoline, perfume, cigarette smoke, or cooking fumes, evaporate quickly as air circulates through a space. Investigators must immediately observe, note, and document these fleeting sensory characteristics during initial scene assessment before atmospheric conditions dissipate them completely.

4. (A) P-3, Q-1, R-4, S-2
Forensic evidence packaging requires specific containers tailored to the physical and chemical properties of each exhibit type. Arson debris needs airtight containers like metal cans or nylon bags to retain volatile hydrocarbons. Wet bloodstained items must dry in paper bags to prevent decay. Small glass fragments fit druggist folds, while liquid blood requires glass vials with chemical additives.

5. (A) To ensure background material does not interfere with testing
A substrate control consists of unstained surface material collected adjacent to the area where biological or chemical evidence was deposited. Testing this background material allows forensic analysts to determine whether the underlying substrate itself contains chemicals, dyes, or impurities that could interfere with analytical reactions or produce false-positive results during laboratory testing procedures.

6. (D) To separate residents' latent prints from those of the perpetrator
Elimination fingerprints are reference prints collected from individuals who legally reside at or frequently access a crime scene. Obtaining these standard prints allows fingerprint examiners to compare and filter out prints left by innocent occupants. This step isolates unknown friction ridge impressions left by actual suspects, narrowing down the focus of forensic identification efforts.

7. (D) Statement I is incorrect but Statement II is correct
Biological evidence should never be sealed in plastic bags while still wet because trapped moisture fosters rapid bacterial and fungal growth, leading to putrefaction and DNA degradation. Standard forensic procedures require wet biological stains to be thoroughly air-dried before packaging in breathable containers such as paper bags to preserve evidentiary integrity during transport and storage.

8. (A) 2, 1, 4, 3
Crime scene processing follows a strict chronological order to preserve physical evidence. First, the area is secured and cordoned off to prevent contamination. Next, overall photography records the unaltered scene. A rough sketch is then prepared to document precise spatial measurements. Finally, after thorough documentation, physical evidence is systematically collected, packaged, and sealed.

NODIA

9. (D) Swabbing with a sterile water-moistened swab followed by a dry swab
The double-swab technique maximizes the recovery of dried biological stains and touch DNA from non-porous surfaces. The process begins by rubbing the target area with a sterile cotton swab moistened with distilled water to rehydrate and loosen bound cellular material. A second, dry swab is immediately used over the same area to collect remaining liquid and cells.

10. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Ethylenediaminetetraacetic acid acts as a powerful anticoagulant and preservative for whole blood samples collected for genetic analysis. By chelating divalent cations such as magnesium and calcium, it inhibits nucleases that break down DNA molecules while simultaneously preventing blood coagulation. This dual chemical action ensures that high-quality intact cellular DNA is successfully preserved for profiling.

11. (A) I and II
Plucking hair ensures that the intact root bulb containing follicular tissue is obtained, which is essential for nuclear DNA extraction. Cutting hair removes only the shaft containing dead keratinized cells suitable primarily for mitochondrial DNA or microscopic examination. Collecting a comprehensive standard reference sample from a suspect requires pulling roughly 50 to 100 head hairs to reflect natural variability.

12. (B) Saturated sodium chloride solution
In Indian medico-legal autopsy practice, saturated sodium chloride solution is the standard preservative for viscera in suspected poisoning cases. Common chemical preservatives like formalin alter or destroy many toxic substances, interfering with chemical analysis. Saturated salt solution preserves tissue structures while acting as an effective antimicrobial agent that does not break down or react with most ingested poisons.

13. (A) Dental Stone provides greater strength and finer detail than PoP.
Dental stone is preferred over Plaster of Paris for casting three-dimensional footwear and tire impressions due to its superior compressive strength and minimal dimensional change upon setting. It reproduces fine microscopic details, such as wear patterns and accidental cuts on shoe soles, without crumbling or requiring additional reinforcement, making it the industry standard for impression evidence.

14. (C) Mount the tape adhesive-side down on a contrasting backing card
After a latent fingerprint is developed with powder and lifted using clear lifting tape, the tape must be mounted adhesive-side down onto a rigid backing card. Choosing a card with a contrasting background color enhances visual clarity for examination and photography, while preventing atmospheric exposure, dust contamination, or wrinkling of the delicate transferred ridge details.

15. (D) A paper envelope
Paper envelopes fail to block radio waves, enabling remote network signals to reach a powered-on mobile phone. This allows remote data modification, deletion, or complete wiping by external commands. To isolate digital devices, investigators use signal-blocking enclosures such as Faraday bags, static-shielding metallic pouches, or aluminum foil wrapping, which block cellular, Wi-Fi, and Bluetooth transmissions.

16. (A) P-3, Q-1, R-2, S-4
Toxicological preservation requires matching organs to chemical properties. Stomach contents reveal unabsorbed toxic substances and ingestion routes. Blood serves as the primary fluid for detecting volatile poisons like carbon monoxide. Brain tissue is high in lipophilic compounds, making it crucial for organophosphate cases. The liver functions as the chief metabolic organ where drugs accumulate in high concentrations.

17. (B) Standard paper bags
Standard paper bags are porous and allow volatile petroleum distillates and accelerant vapors to escape rapidly into the atmosphere. Arson evidence must be sealed inside non-porous containers such as clean, unused metal paint cans, heavy glass jars, or specialized nylon evidence bags to trap volatile hydrocarbon fumes for subsequent gas chromatography analysis in the laboratory.

18. (D) Only from the top surface layer
When collecting standard or reference soil samples for comparison with soil transferred onto shoes or clothing, samples must be taken strictly from the uppermost surface layer. Soil composition, mineralogy, and organic content

Downloaded from www.pdf.tube

vary significantly with depth; collecting deeper soil layers would not accurately represent the surface material that a person walks on and transfers during contact.

19. (A) Conditional evidence
Conditional evidence consists of information produced by an event or action at a scene, describing the specific state or environmental status of physical surroundings. Examples include lighting conditions, room temperature, door lock settings, window positions, and smoke density. These observations provide vital context regarding how the event occurred and help investigators reconstruct the exact chronological sequence of events.

20. (A) I only
Inserting objects like pencils, pens, or screwdrivers into a firearm barrel destroys delicate trace evidence, such as gunshot residues, gunpowder flakes, and striation marks within the rifling. It also risks depositing foreign metal or wood contaminants. Firearms should be picked up carefully by textured grip surfaces or guard areas using gloved hands to preserve evidentiary integrity.

21. (A) To prove the evidence in court is unchanged from collection and untampered with
Maintaining a rigorous chain of custody establishes a complete, unbroken record detailing the collection, transfer, analysis, and storage of physical evidence. This documentation accounts for every individual who handled the item and verifies that the exhibit presented in court is in substantially the same condition as when recovered, free from unauthorized tampering, alteration, or substitution.

22. (D) Slide rigid card under document → place in rigid box → pad with cotton → seal
Charred documents are extremely fragile and crumble easily upon contact. The safest procedure requires sliding a stiff piece of cardboard gently under the burnt paper to lift it without mechanical disturbance. The document is placed into a rigid container, loosely padded with soft cotton wool to prevent shifting during movement, and then securely sealed for laboratory submission.

23. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Wet biological items such as bloodstained garments must be thoroughly air-dried at room temperature before packaging. Sealing wet biological materials in airtight containers traps moisture, creating an environment that accelerates bacterial and fungal proliferation. Microbial activity rapidly degrades double-stranded DNA and alters serological markers, destroying crucial genetic evidence needed for identification and testing.

24. (C) Suspect tool recovered → Insert the tool into the mark to see if it fits perfectly
Investigators must never insert a recovered tool into a crime scene impression to check for alignment. Doing so can alter microscopic detail, scratch the impression, or deposit fresh tool marks, destroying unique individual characteristics. Comparative analysis is properly conducted in laboratory settings by making test impressions using the suspect tool on soft control materials.

NODIA

25. (D) Scrape paint down to bare substrate using a clean blade
Paint on vehicles consists of multiple layers, including primer, base coat, and clear coat. To obtain a representative sample for forensic comparison, analysts require all distinct layers. Scrape down to the bare underlying metal or plastic substrate with a clean blade to capture the complete cross-sectional sequence, enabling accurate physical and chemical layer comparisons.

26. (A) Sodium fluoride and potassium oxalate
Blood samples collected for alcohol concentration testing require sodium fluoride as a preservative and potassium oxalate as an anticoagulant. Sodium fluoride inhibits enzyme activity and prevents microbial fermentation that could produce ethanol post-collection. Potassium oxalate prevents blood coagulation, ensuring a homogeneous liquid sample suitable for precise headspace gas chromatography analysis.

27. (B) Package the entire bedsheet in a paper bag and submit it to the laboratory
When dried biological stains are located on moveable objects, standard practice dictates submitting the entire item to the laboratory. Packaging the intact bedsheet in a breathable paper bag prevents stain disturbance, flake loss,

or cross-contamination. Laboratory experts can then examine the full item under controlled lighting conditions to identify, map, and sample stains.

28. (A) Both Statement I and Statement II are correct
Tape lifting efficiently collects loose trace fibers transferred onto clothing or upholstery. Clear adhesive tape strips are pressed across the target surface to pick up loose particles. Once lifted, the tape is adhered onto a clear plastic sheet or glass slide, securing the fibers in position while protecting them from contamination during transport and evaluation under a microscope.

29. (B) II and III
Glass fragments gathered from separate locations must be packaged independently to avoid intermixing evidence from distinct origins. Fragments require packaging in rigid, cushioned containers to prevent breakage during transit. Examining radial and concentric fracture patterns enables analysts to determine the direction of impact force and reconstruct the sequence of impacts breaking the glass structure.

30. (B) 10 to 20 ml
During medico-legal autopsies in India, preserving 10 to 20 milliliters of blood is standard practice for toxicological analysis. This quantity ensures a sufficient sample volume for routine screening and confirmatory assays, including blood alcohol quantification, systematic drug detection, and poison identification, while allowing duplicate re-testing if initial analytical results require judicial verification.

31. (D) To securely package small trace evidence without leakage
A druggist fold, or paper bindle, is a folded paper envelope constructed to package small, dry trace evidence like glass particles, paint chips, hair, or powder. Its overlapping folds enclose tiny particles securely, preventing loss through container corners during transport before the bindle is placed inside a secondary outer envelope.

32. (A) 2, 3, 4, 1
The double-swab technique for collecting dry biological stains follows a precise step-by-step order. First, a sterile swab is moistened with distilled water. This moist swab is rubbed over the stain to dissolve and lift dry cellular material. A second dry swab is immediately used to capture residual moisture. Finally, both swabs are completely air-dried before packaging.

33. (A) P-2, Q-1, R-4, S-3
Presumptive tests target specific biochemical components unique to body fluids. Saliva screening detects amylase enzymatic activity. Semen identification targets acid phosphatase secreted by the prostate gland. Blood identification relies on hemoglobin catalyzing peroxidase-like color reactions. Sweat and skin contact stains provide nucleated epithelial cells utilized directly as target sources for DNA profiling.

34. (D) Combining residues from multiple locations into one single evidence bag
Combining evidence gathered from different locations into a single container causes cross-contamination and destroys the contextual integrity of physical evidence. During post-blast investigations, chemical residues recovered from distinct spots, such as the blast crater epicenter or surrounding debris, must be packaged separately in clean, airtight containers to allow precise chemical mapping and source identification.

35. (A) To block network signals and prevent remote data wiping or modification
A Faraday bag acts as a conductive shield that blocks external electromagnetic signals, preventing incoming cellular, Wi-Fi, and Bluetooth transmissions. Placing a mobile device inside isolates it from wireless networks, preventing suspects or accomplices from initiating remote wiping commands, altering digital evidence, or modifying stored data prior to forensic extraction.

36. (C) Material of known origin collected for comparative forensic analysis
A reference sample, or standard sample, consists of material whose origin is definitively known and documented. Examples include blood drawn from a known individual, hair plucked from a suspect, or paint scraped from a known vehicle. These known samples are compared directly with questioned evidence recovered from crime scenes to establish associations or exclusions.

Click Here to Buy book on Amazon

37. (B) II only
When physical exhibits are forwarded to a Forensic Science Laboratory, official procedures demand documentation to track transfer. A Road Certificate must accompany the exhibits whenever they are dispatched, even when carried directly by a special police messenger. This certificate provides an official record confirming authorization, transit details, and continuity of custody.

38. (D) Measure the tool, cast the marks, and package them separately
When encountering pry marks and a suspected tool at a scene, investigators must never insert the tool into the impression. To preserve evidence, the mark should be measured, photographed with a scale, and cast using silicone moulding material. The suspect tool and the cast must then be packaged in separate containers to prevent cross-contamination.

39. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
When sealing evidence parcels, a sample impression of the official seal must be retained and a copy sent alongside the forwarding documentation to the laboratory. Upon arrival, laboratory personnel inspect the physical wax or ink seal on the parcel against the specimen seal to confirm that packaging was not compromised, opened, or altered during transit.

40. (C) The independent witness in whose presence sealing occurred
To maintain process integrity and prevent post-seizure tampering, standard police procedure requires handing the metallic specimen seal to an independent witness who observed the sealing procedure. Keeping the seal out of the investigating officer's possession until the parcel reaches the laboratory ensures that the officer cannot reopen or re-seal the evidence packet unnoticed.

41. (D) The specific lab testing methods used for analysis
A Chain of Custody form is a legal log designed to track physical possession, custody, and transfer of evidence. It documents item descriptions, seizure dates, transfer times, and signatures of individuals handling the exhibit. Specific laboratory analytical techniques and testing methodologies are documented in formal forensic laboratory reports rather than on custody logs.

42. (A) Hydrocarbon vapours easily permeate polyethylene bags, losing evidence
Polyethylene plastic bags are permeable to volatile organic compounds, allowing petroleum hydrocarbon vapors from accelerants to diffuse through the plastic material and escape into the air. Forensic collection of arson evidence requires impermeable packaging such as specialized nylon evidence bags or clean metal paint cans to retain trapped accelerant vapors for laboratory testing.

43. (B) Crime Scene → Investigating Officer → Police Station Property Room (Malkhana) → Forensic Science Laboratory
The standard chain of custody movement begins when physical evidence is recovered at the crime scene by the investigating officer. The officer secures and transports the item to the police station property room (Malkhana) for safe registration and logging. Subsequently, the exhibit is officially dispatched from the property room to the forensic science laboratory.

NODIA

44. (B) Zip-lock plastic bags
Zip-lock plastic bags trap moisture inside, creating a humid environment that promotes microbial and fungal growth, leading to biological evidence decay. In contrast, porous and breathable containers like heavy paper bags, cardboard storage boxes, and manila envelopes allow air circulation, preventing condensation and preserving biological samples for subsequent forensic analysis.

45. (A) P-1, Q-2, R-3, S-4
Standard viscera preservation relies on saturated sodium chloride, but in phenol poisoning, rectified spirit is avoided as it dissolves carbolic acid. Blood alcohol samples require sodium fluoride and potassium oxalate to inhibit microbial ethanol production and coagulation. Blood collected for DNA profiling utilizes EDTA to preserve white blood cell nucleic acids without enzymatic degradation.

46. (C) I and III
Packaging each exhibit separately prevents cross-contamination between items. Wet biological evidence must never be stored long-term in non-breathable airtight containers at room temperature, as trapped moisture causes rapid

66. (D) In a paper envelope where particles can leak out
Soil samples should never be packaged in standard paper envelopes because fine mineral grains and dust particles easily leak through folded corner gaps. Soil packaging requires rigid, leak-proof containers such as glass vials, plastic tubs, or sealed pillboxes to ensure complete sample retention and prevent cross-contamination during transit to the laboratory.

67. (A) Pat tape over the seat until tackiness is lost, then stick onto a clear backing card
Forensic tape lifting involves repeatedly pressing clear sticky tape onto target surfaces like vehicle seats until the adhesive loses tackiness from picking up trace materials. The tape is then pressed flat onto a transparent vinyl or acetate backing card, securing transferred fibers and particles while protecting them for microscopic examination.

68. (C) Brain tissue
In routine Indian autopsy procedures, three standard wide-mouthed glass jars are used: Jar 1 contains the stomach and its contents; Jar 2 holds the liver, spleen, and kidneys; Jar 3 contains blood and urine. Brain tissue is not routinely preserved in these three primary containers unless specific neurotoxic or organophosphate poisoning is suspected.

69. (A) To measure cholinesterase enzyme activity inhibition
Organophosphate compounds exert toxicity primarily by inhibiting acetylcholinesterase enzyme activity within central and peripheral nervous tissues. Preserving brain tissue separately allows forensic toxicologists to directly measure cholinesterase enzyme inhibition levels. This neurochemical assessment confirms organophosphate poisoning as the cause of death, providing crucial physiological evidence for legal investigations and judicial proceedings.

70. (D) Place it flat and unfolded in a cellophane folder or heavy manila envelope
Document evidence must be preserved in its original physical state without introducing artificial creases, folds, or mechanical damage. Folding, stapling, or applying moisture destroys subtle physical features like paper grain, line intersections, and pen indentations. Transporting documents flat inside protective cellophane sleeves or heavy manila envelopes protects against friction, contamination, and creasing.

71. (B) Chip out the brick section, scrape the stain, or swab with a moist swab
When bloodstains are located on immovable porous masonry structures like brick walls, investigators can chip away the stained brick portion, scrape dried crusts into paper bindles, or swab using distilled water. Destructive thermal methods like blowtorches or non-sampling chemical applications like luminol destroy DNA or prevent physical collection required for analysis.

72. (C) Perfume or smoke odors in a closed room
Transient evidence encompasses temporary scene conditions that easily change, degrade, or dissipate over short periods. Odors from perfumes, smoke, or volatile chemicals represent classic transient evidence because ambient ventilation rapidly disperses air molecules. Investigators must observe and document such sensory details immediately upon arrival before environmental conditions cause them to disappear completely.

73. (C) Statement I is correct but Statement II is incorrect
Paper bags are ideal containers for biological evidence because breathable paper allows moisture to evaporate, preventing microbial growth and DNA destruction. Conversely, plastic bags should never be used for long-term biological evidence storage—even for dried stains—because sealed plastic can trap ambient condensation, creating high humidity that promotes mold and sample degradation.

74. (A) Liquid blood samples for DNA testing
Liquid blood samples collected for genetic analysis require continuous refrigeration at two to eight degrees Celsius when immediate lab transport is delayed. Cold temperatures slow enzymatic breakdown and inhibit microbial growth that degrades DNA. Non-biological physical exhibits, such as paint chips, cartridge cases, or plaster casts, remain stable at room temperature without refrigeration.

75. (B) The fingerprints of lawful occupants and residents
In burglary investigations, elimination fingerprints are taken from lawful occupants, family members, and regular visitors of

Downloaded from www.pdf.tube

STUDYING FROM PDFs?

THINK AGAIN.

If you are studying only from PDFs,
you are wasting valuable time.

Research shows that learning from

PRINTED BOOKS has up to

4× HIGHER RETENTION

than studying from screens.

PRINT BOOK = BETTER MEMORY

PDF = LOWER RETENTION

Those who study from **PRINTED BOOKS**
move **AHEAD.**

Others are left **BEHIND**
in competition.

In competitive exams,
being average is not enough.

STAY ONE STEP AHEAD.

and leading to extensive hemolysis and cellular lysis. Intact cellular components are required for specific serological assays and cell-separation procedures. Consequently, liquid whole blood samples should be kept refrigerated at 2 to 8 degrees Celsius rather than frozen in standard storage.

57. (D) Using a hair dryer on high heat to speed up the drying process
Applying direct heat using a hair dryer to dry bloodstained evidence thermally denatures heat-sensitive proteins and causes thermal degradation of cellular DNA. Standard drying procedures require hanging garments in a secure, well-ventilated cabinet or drying room at ambient room temperature, allowing moisture to evaporate naturally without altering organic evidence composition.

58. (A) Using the double-swab technique on the bite mark
Recovering perpetrator saliva from a bite mark on a living victim requires gentle swabbing to avoid scraping skin epithelial cells from the victim. The double-swab technique uses a water-moistened swab to rehydrate and lift salivary proteins and epithelial cells from the skin surface, followed immediately by a dry swab to collect residual moisture efficiently.

59. (C) 50 to 100 hairs
Hair exhibits natural variations in color, diameter, pigment distribution, and cross-sectional shape across different regions of the scalp. To collect a representative standard reference sample from a suspect or victim, forensic guidelines require pulling roughly 50 to 100 full-length head hairs with intact roots, ensuring comprehensive coverage of natural microscopic characteristics.

60. (B) Unplug the power cable from the back and seize the PC
If a desktop computer is powered off at a crime scene, booting it up alters volatile system metadata, changes access timestamps, and potentially triggers destructive scripts installed by a suspect. First responders should leave the machine powered off, disconnect the main power cable from the back, and transport the device securely for laboratory imaging.

NODIA

61. (B) Both Statement I and Statement II are incorrect
Marking initials directly on the primer or base of a fired cartridge case damages unique firing pin, breechface, or ejector marks essential for ballistic comparison. Similarly, marking the bearing surface of a fired bullet defaces rifling striations. Identifications should be recorded on packaging or at the bullet nose and cartridge case neck.

62. (C) Across the seal flap, bridging the label and wrapper
Signatures of investigating officers and witnesses should be placed across the seal flap, straddling both the label and outer packaging. This positioning ensures that opening the parcel breaks the signature continuity, leaving clear visual proof of any tampering or unauthorized access while maintaining strict evidence security throughout transportation and storage.

63. (D) From an undamaged area near the damaged site
Standard paint samples from a vehicle involved in an investigation must be collected from an undamaged area adjacent to the impact zone. Collecting from undamaged paint ensures that the baseline sample contains all complete original factory coating layers down to the metal substrate without contamination or scraping loss caused by collision damage.

64. (D) I, II, and III
Digital evidence preservation mandates blocking mobile network connectivity using airplane mode or Faraday shielding to prevent remote commands. Abruptly pulling batteries from modern devices is avoided because it can trigger full-disk encryption locks or wipe volatile memory. Any removed SIM or memory cards must be cataloged and preserved as separate physical exhibits.

65. (C) 3 to 4 feet (or the full circumference of a standard tyre)
Casting tire impressions requires capturing a section long enough to represent at least one full rotational circumference of a standard automobile tire, typically three to four feet. Recording a complete revolution ensures that all recurring tread wear patterns, embedded debris marks, and individual defect characteristics are documented for comparison against suspect vehicles.

through the long axes of bloodstains meet
2. Created by blood flung from a blood-bearing object in motion
3. Created when a wet, bloody surface touches another surface
4. The dried perimeter of a bloodstain left behind when the center is wiped

(A) P-2, Q-1, R-4, S-3
(B) P-1, Q-2, R-3, S-4
(C) P-4, Q-3, R-1, S-2
(D) P-2, Q-4, R-1, S-3

26. In three-dimensional space, the location from which blood was projected is known as the:
(A) Area of convergence
(B) Area of origin
(C) Area of impact
(D) Void volume

27. The traditional physical technique used by investigators to determine the 3D area of origin of blood spatter by extending physical lines from the stains is known as the:
(A) Stringing method
(B) Tangent method
(C) Grid method
(D) Plotting method

28. To calculate the height of the area of origin using the tangent method, an investigator must know the distance to the area of convergence and the:
(A) Terminal velocity of blood
(B) Volume of the blood droplet
(C) Angle of impact
(D) Blood group of the victim

29. Software-based bloodstain pattern analysis such as Hemospat or BackTrack utilizes computational algorithms primarily to:
(A) Identify the individual STR DNA profile directly from high-resolution digital photographs of bloodstains
(B) Determine the precise elapsed time and age of deposited bloodstains in hours based on color degradation
(C) Detect faint or latent bloodstains on dark porous surfaces without utilizing chemical reagents like luminol
(D) Automate 3D area of convergence and origin calculations from digital images

30. Consider the following statements regarding the directionality of a bloodstain:
I. The pointed end (tail) of a blood drop always points in its direction of travel.
II. The scalloped edges or satellite spatter are typically found on the side opposite to the direction of travel.
III. A perfectly circular drop indicates an angle of impact of approximately 90 degrees.

Which of the above statements is/are correct?
(A) I and II only
(B) I and III only
(C) II and III only
(D) I, II, and III

31. In trajectory reconstruction of a shooting incident, calculating the bullet's flight path mathematically requires a minimum of how many reference points (e.g., bullet holes) created by the single projectile?
(A) One
(B) Two
(C) Three
(D) Four

32. Which of the following tools is most commonly used in modern forensic ballistics to visualize the flight path of a bullet across a large, open crime scene?
(A) Luminol chemical reagent spray for blood detection
(B) Cyanoacrylate ester fuming wands for latent prints
(C) Ground-penetrating radar systems for buried evidence
(D) Laser-equipped trajectory rods

33. When a bullet strikes a firm surface at a shallow angle and bounces off, leaving a characteristic mark on the surface, this event is technically referred to in reconstruction as a:
(A) Ricochet
(B) Blowback
(C) Keyholing
(D) Mushrooming

34. In reconstructing a shooting involving a glass window, an investigator examines a bullet hole. How can they determine which side was the entry side and which was the exit side?
(A) The entry side consistently exhibits a significantly wider crater and extensive beveling than the exit side
(B) The exit side will always display heavy concentrations of unburned gunpowder particles and gunshot residue
(C) The exit side exhibits wider beveling and

Click Here to Buy book on Flipkart

the premises. These reference prints enable fingerprint examiners to compare and exclude friction ridge impressions belonging to innocent residents, thereby isolating unassigned latent prints left by the actual perpetrator at the crime scene for further evaluation.

76. (B) Polyethylene bags
Polyethylene bags are unsuitable for packaging fire debris suspected of containing accelerants because petroleum hydrocarbon vapors readily permeate polyethylene walls, leading to loss of volatile chemical evidence. Instead, arson investigators utilize non-permeable containers such as clean metal paint cans, glass Mason jars, or specialized nylon evidence bags to trap hydrocarbon vapors.

77. (A) The weapon's evidentiary value is severely compromised due to potential tampering
A breach in the chain of custody creates a legal gap in accounting for evidence handling and security. If an officer retains evidence unrecorded overnight, defense counsel can challenge its integrity in court, raising reasonable doubt regarding potential contamination, substitution, or tampering. This vulnerability severely diminishes or destroys the legal admissibility of the exhibit.

78. (C) Silicone rubber material (e.g., Mikrosil)
Silicone rubber casting compounds, such as Mikrosil, are the preferred material for capturing detailed toolmarks on surfaces like wooden window frames. Silicone provides exceptional dimensional stability, high flexibility upon curing, and superior resolution of microscopic striations and tool marks without adhering to or damaging original wooden substrate surfaces during cast removal.

79. (D) Histopathological examination → Preserved in 10% Formalin
Ten percent neutral buffered formalin is the standard fixative used for preserving tissue specimens intended for histopathological examination. Formalin cross-links structural proteins, preserving microscopic cellular architecture and tissue morphology for histological sectioning and microscopic evaluation. In contrast, formalin destroys DNA and interferes with toxicological or corrosive acid testing procedures in forensic laboratories.

80. (C) Leave soil intact on the shoe, pack shoe in paper bag, send to lab
When dry soil adheres to shoe treads, investigators should leave the soil completely intact on the shoe rather than scraping or brushing it off at the scene. Packaging the entire shoe securely in a breathable paper bag prevents soil dislodgement and contamination, allowing laboratory analysts to examine surface layer distributions carefully under controlled conditions.

81. (C) Register No. 19 (Malkhana Register)
Register No. 19, universally known as the Malkhana Register, is the official police station ledger used for recording all seized property and physical evidence exhibits. It maintains detailed accounts of item descriptions, seizure particulars, officer deposits, temporary withdrawals for laboratory analysis or court proceedings, and official disposals to preserve evidence tracking.

82. (A) Both Statement I and Statement II are correct
Blood samples drawn for ABO serological blood grouping are collected in plain tubes without anticoagulants, allowing natural clot formation. As red blood cells coagulate, they separate from the yellowish clear fluid called serum. Collecting unadulterated serum enables serologists to perform tube agglutination testing to identify naturally occurring anti-A and anti-B antibodies accurately.

83. (A) Which surface faced inside and which faced outside
Applying the 3R rule (Radial fractures form Right angles on the Rear side of force) requires determining which face of a broken glass pane was oriented toward the interior or exterior. Marking glass orientation on collected fragments before removal allows examiners to determine direction of force, identifying whether impact occurred from inside or outside a building.

84. (C) FIR number, item description, seizure date/time, IO and witness signatures
An evidence label establishes legal tracking and identification for seized items. Standard forensic protocol requires recorded evidence labels to display essential metadata, including First Information Report number, brief item description, exact date and time of seizure, location, and official signatures of both

Downloaded from www.pdf.tube

possible information and physical evidence from the scene.
II. Hypothesis formation requires the investigator to ignore witness statements to remain completely objective.
III. Testing the hypothesis involves evaluating it against all known physical evidence to check for inconsistencies.
Which of the above statements is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

9. Why is falsification a critical component of testing a hypothesis in crime scene reconstruction?
(A) It proves the guilt or innocence of a primary suspect beyond any reasonable doubt during trial
(B) It eliminates hypotheses contradicted by the physical evidence at the scene
(C) It allows investigators to adjust physical evidence interpretations to align with witness testimony
(D) It eliminates the necessity for detailed forensic laboratory analysis of physical trace evidence

10. The recognition of a staged crime scene is fundamentally dependent on identifying what type of forensic anomaly?
(A) The unexpected presence of a large volume of biological fluid evidence across the scene
(B) Discrepancies between physical evidence and reported events
(C) The complete absence of latent fingerprints on smooth non-porous surfaces at the location
(D) The strategic presence of multiple unobstructed exit routes throughout the property

11. In Bloodstain Pattern Analysis (BPA), what physical property of blood causes a falling drop to maintain a spherical shape in flight?
(A) Surface tension
(B) Viscosity
(C) Specific gravity
(D) Terminal velocity

12. Which of the following patterns is classified strictly as a passive bloodstain?
(A) Cast-off pattern
(B) Arterial spurt pattern
(C) Drip pattern
(D) Expirated blood pattern

13. A flow pattern in bloodstain analysis provides investigators with crucial information regarding:
(A) The total number of force impacts delivered by a bludgeoning weapon during an assault
(B) The precise caliber and specific velocity of the firearm projectile used in the incident
(C) The presence of respiratory fluids such as saliva or mucus mixed directly with the blood
(D) The movement of a bloodied body or object relative to gravity after deposition

14. Consider the following statements regarding bloodstain pattern analysis:
I. A pool pattern forms when blood collects on a level, undisturbed surface.
II. Skeletonization of a bloodstain occurs when the edges of a stain dry, leaving a ring if the central area is altered.
III. High-velocity impact spatter typically creates droplets larger than 5 mm in diameter.
IV. A void pattern indicates the presence of an object that blocked the deposition of blood spatter.
Which of the above statements are correct?
(A) I, II, and III only
(B) I, II, and IV only
(C) II, III, and IV only
(D) I, III, and IV only

15. A bloodstain pattern created when a wet, bloody surface comes in contact with a secondary surface is known as a:
(A) Projected pattern
(B) Transfer pattern
(C) Impact spatter
(D) Expirated pattern

16. What is the fundamental difference between a "swipe" pattern and a "wipe" pattern in crime scene reconstruction?
(A) A swipe occurs when a clean object moves through a wet stain; a wipe occurs when a bloody object transfers blood onto an untouched surface
(B) Swipes are produced primarily by arterial spurting pressure; wipes are produced exclusively by expirated air from the respiratory tract
(C) Swipes consistently form circular transfer patterns; wipes consistently form linear drag

NODIA

CHAPTER 08
Crime Scene Reconstruction

1. What is the primary objective of crime scene reconstruction in forensic investigation?
(A) To determine the sequence of events and actions that occurred during the crime
(B) To visually document the scene for media presentation
(C) To identify the chemical composition of trace evidence
(D) To secure the crime scene from unauthorized entry

2. Which of the following best distinguishes crime scene "re-enactment" from crime scene "reconstruction"?
(A) Re-enactment involves hypothesizing based on evidence, while reconstruction involves actors physically portraying the events
(B) Re-enactment is performed by forensic scientists in a lab, while reconstruction is performed by witnesses at the scene
(C) Re-enactment involves individuals acting out a hypothesized version of events, while reconstruction relies strictly on scientific analysis of physical evidence to determine what occurred
(D) There is no distinction; both terms refer to the exact same forensic process

3. In the context of crime scene reconstruction, what does "relational reconstruction" primarily focus on?
(A) Establishing the physical position and orientation of objects and individuals relative to one another
(B) Determining the chronological order of events
(C) Identifying the specific direction from which a force was applied
(D) Evaluating conditional evidence such as lighting and temperature

4. Which category of reconstruction specifically deals with determining whether an action occurred before or after another action based on physical evidence like overlapping bloodstains or terminating glass fractures?
(A) Directional determination
(B) Relational determination
(C) Conditional determination
(D) Sequence determination

5. Which of the following options represents the correct sequence of the scientific method as applied to crime scene reconstruction?
(A) Hypothesis formation → Data collection → Theory formulation → Testing
(B) Data collection → Hypothesis formation → Testing and verification → Conclusion
(C) Testing and verification → Data collection → Conclusion → Hypothesis formation
(D) Hypothesis formation → Testing and verification → Data collection → Conclusion

6. Conditional evidence is crucial for certain types of crime scene reconstruction. Which of the following is an example of conditional evidence?
(A) A spent 9mm cartridge casing
(B) A latent fingerprint on a window pane
(C) The state of the lights (on or off) in a room at the time of discovery
(D) A bloodstained knife found under a bed

7. According to Locard's Exchange Principle, a perpetrator will bring something into the crime scene and leave with something from it. How is this principle most directly utilized in crime scene reconstruction?
(A) By establishing the financial motive of the accused through circumstantial financial records
(B) By calculating the time since death through body heat loss and post-mortem cooling rates
(C) By determining the psychological and behavioral profile of the perpetrator from crime scene traits
(D) By linking a suspect to the scene or victim through transferred physical trace evidence

8. Consider the following statements regarding the stages of crime scene reconstruction:
I. Data collection involves initially gathering all

Click Here to Buy book on Amazon

fungal degradation. Using breathable containers like paper bags allows moisture to evaporate, preventing putrefaction and preserving biological samples for subsequent forensic testing.

47. (D) The Superintendent of Police or Chief Medical Officer
In standard police and medico-legal protocol in India, physical evidence exhibits collected during criminal investigations are formally forwarded to the Forensic Science Laboratory under the official authority, cover letter, and signature of the Superintendent of Police or, in post-mortem cases, the Chief Medical Officer of the concerned district.

48. (C) Dig out the bullet using metal forceps or pliers
Using metal forceps, pliers, or sharp metallic tools directly on an embedded bullet scratches its soft lead or jacketed surface, introducing artificial striations that obliterate original barrel rifling marks. To preserve toolmark evidence, investigators cut away surrounding wood or use soft rubber-tipped instruments to extract the bullet safely without surface damage.

49. (D) Statement I is incorrect but Statement II is correct
Rubbing a pencil over indented writing permanently alters and ruins document evidence, preventing specialized non-destructive analysis using Electrostatic Detection Apparatus or oblique lighting. Questioned documents must remain physically unaltered, kept flat, and handled with clean gloves or forceps to avoid depositing latent fingerprints or altering delicate surface features essential for forensic analysis.

50. (D) Unload the weapon while logging cylinder and cartridge positions, then package securely
A loaded firearm poses severe safety hazards during handling and transportation. Before packaging, an investigator must safely unload the revolver while carefully documenting the exact position of fired and unfired cartridges in relation to the cylinder chambers and hammer. The unloaded firearm and ammunition are then packaged in separate secure containers.

51. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Trace evidence such as loose hair, fibers, and glass fragments loosely adhering to a victim's body or clothing is highly fragile. Moving or wrapping the body for transportation can easily dislodge these particles or transfer external contaminants. Collecting transient trace materials at the initial crime scene before body removal preserves vital forensic evidence.

52. (C) About one-third of the volume
When preserving anatomical viscera in glass jars with saturated salt solution, leaving roughly one-third of the container volume empty is essential. Post-mortem tissue degradation generates putrefactive gases that expand within the container. Leaving adequate air space prevents internal gas pressure buildup, which could otherwise burst the glass jar or cause leakage during transport.

53. (A) Unburnt carpet from an unaffected area of the same room
A substrate control in fire investigations consists of undamaged material identical to the surface where accelerants are suspected, collected from an unburnt area of the same room. Testing this clean substrate allows analysts to verify whether pyrolysis products from the carpet backing itself interfere with chemical detection of ignitable liquid residues.

54. (D) Blood for DNA analysis → Formalin
Formalin cross-links protein structures and causes severe chemical fragmentation of DNA, preventing polymerase chain reaction amplification and molecular profiling. Blood intended for DNA analysis should be preserved using EDTA or stored dried on filter paper without formalin. Other listed preservatives, such as no additives for grouping and sodium fluoride for urine, are correctly applied.

NODIA

55. (C) I, III, and IV
In police station administration across India, Register No. 19 is officially designated as the Malkhana Register. It maintains an official log of all seized case properties, recording their inward receipt, custody transfers, dispatches to forensic science laboratories, and final disposal. Signatures of individuals depositing or withdrawing exhibits are mandatory to maintain chain of custody integrity.

56. (C) Tubes of liquid whole blood
Freezing tubes of liquid whole blood causes water crystallization, expanding red blood cells

marks across target surfaces
(D) A swipe transfers blood from a bloody object onto a clean surface; a wipe moves an object through an existing stain

17. Impact spatter is often classified by the velocity of the force applied to the blood source. A bloodstain pattern characterized by mist-like droplets, typically less than 1 mm in diameter, is most commonly associated with:
(A) High-velocity impact (e.g., gunshot wound)
(B) Low-velocity impact (e.g., blood dripping into blood)
(C) Medium-velocity impact (e.g., blunt force trauma)
(D) Cast-off from a swinging weapon

18. Cast-off patterns are frequently used in reconstruction to determine which of the following?
(A) The exact time of day that the physical assault occurred
(B) The precise caliber and model of the firearm utilized
(C) The minimum number of blows struck
(D) The estimated post-mortem interval of the deceased victim

19. An arterial spurt pattern is typically identifiable by which distinct characteristic?
(A) Pulsating or wave-like stain patterns matching heart contractions
(B) Very fine mist-like blood droplets distributed uniformly across an exceptionally large surface area
(C) A complete absence of tailing or peripheral spines on all deposited individual blood drops
(D) Perfectly circular bloodstains formed by drops falling vertically at an exact ninety-degree impact angle

20. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Expirated blood patterns can sometimes be confused with high-velocity impact spatter.
Reason (R): Both expirated blood and high-velocity impact spatter may consist of very fine, mist-like blood droplets.
In the light of the above statements, choose the correct answer from the options given below:
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

21. Which specific feature can help a forensic scientist differentiate an expirated blood pattern from a regular impact spatter during reconstruction?
(A) The presence of completely perfectly circular stains regardless of the surface
(B) The presence of air bubbles in the bloodstains and dilution from saliva
(C) A perfectly straight line of blood droplets
(D) The occurrence of the stains strictly on the floor

22. A void pattern in a heavily blood-spattered room is most useful in reconstruction for determining:
(A) The specific ABO blood group or genetic markers belonging to the deceased victim
(B) The precise standing or crouching physical height of the victim during the incident
(C) The location of an object or person present during bloodshed but later moved
(D) The exact strike velocity and force of the blunt or sharp weapon used in the assault

23. The angle of impact for a blood drop can be calculated using the mathematical relationship between its width (W) and length (L). Which of the following is the standard formula used?
(A) $\cos(\theta) = W / L$
(B) $\tan(\theta) = W / L$
(C) $\sin(\theta) = L / W$
(D) $\sin(\theta) = W / L$

24. If a forensic scientist measures a blood drop and finds its width is 5 mm and its length is 10 mm, what is the estimated angle of impact?
(A) 15 degrees
(B) 30 degrees
(C) 45 degrees
(D) 60 degrees

25. Given below are two lists. Match List I with List II.
List I: Bloodstain Pattern Term
P. Cast-off pattern
Q. Area of convergence
R. Skeletonization
S. Transfer pattern
List II: Description
1. The 2D intersection where lines drawn

Downloaded from www.pdf.tube

investigating officer and independent witnesses present during recovery.

85. (A) Inserting the tool into the mark to test for a match
Inserting a suspect tool directly into a crime scene toolmark impression is a critical error. Physical contact can alter microscopic ridge features, scratch surface impressions, or deposit tool metal fragments, invalidating the evidence. Physical tool comparisons must be conducted exclusively in laboratory environments using test impressions created on soft receiving materials.

86. (D) Saturated sodium chloride solution
In cases of suspected carbolic acid (phenol) poisoning, saturated sodium chloride solution is the required preservative for anatomical viscera. Rectified spirit is strictly avoided because alcohol dissolves phenol, interfering with toxicological extraction and quantitative analysis. Saturated sodium chloride preserves tissue architecture without dissolving or altering phenol chemical structure during forensic testing.

87. (B) Dabbing hands with adhesive GSR stubs or swabbing with 5% nitric acid
Collecting gunshot residue from a suspected shooter's hands involves dabbing skin surfaces with aluminum adhesive stubs for scanning electron microscopy or swabbing with cotton swabs moistened with five percent nitric acid for atomic absorption spectroscopy. These methods capture inorganic primer residues, including lead, barium, and antimony, without contaminating skin surfaces.

88. (C) Each item of clothing must be packaged in its own separate paper bag to prevent cross-contamination.
Each garment recovered from a victim or suspect must be air-dried and packaged independently in its own separate paper bag. Packaging clothing items together causes physical contact transfer, leading to cross-contamination of biological stains, hairs, and trace fibers between garments, which severely compromises the reliability of forensic trace laboratory testing.

89. (D) A substrate control
A swab collected from an unstained area adjacent to an evidence stain is termed a substrate control. Laboratory analysis of the substrate control ensures that chemical background interference, cleaning agent residues, or physical dyes inherent to the floor material do not alter presumptive color tests or produce false results during DNA testing.

90. (A) A clean wide-mouthed glass jar with an airtight lid
Viscera suspected of containing volatile poisons, such as alcohols, cyanides, or inhalants, must be packaged in clean, wide-mouthed glass jars equipped with airtight sealing lids. Non-porous glass prevents volatile toxic fumes from escaping, while airtight seals maintain container pressure and prevent chemical evaporation or ambient contamination prior to toxicological testing.

www.nodia.in

NODIA

cratering from glass cone displacement
(D) The entry hole is always perfectly square in shape whereas the exit hole forms a symmetrical circle

35. Arrange the following steps for applying the traditional stringing method in bloodstain pattern analysis in the correct sequence:
I. Attach strings at the base of the stains and extend them upward at the calculated angle.
II. Determine the angle of impact for selected representative bloodstains.
III. Identify the 2D area of convergence on the reference surface.
IV. Note the 3D spatial intersection point of the strings as the area of origin.
Choose the correct option:
(A) III → II → I → IV
(B) II → III → I → IV
(C) I → II → III → IV
(D) III → I → II → IV

36. According to the "3R Rule" used in the reconstruction of glass fractures, radial fractures form right angles on which side of the glass?
(A) The specific side where the impacting destructive force was initially applied
(B) Along the outer peripheral edges of surrounding concentric fractures
(C) Equally across both the front and reverse surfaces of the pane
(D) The side opposite to the force (Reverse side)

37. When multiple bullets are fired through a pane of glass, how does a forensic scientist determine the sequence of the shots during reconstruction?
(A) By measuring the relative entry diameter of the projectile holes; the largest hole consistently represents the initial shot
(B) Fracture lines from subsequent shots terminate at pre-existing fracture lines
(C) By analyzing the total weight and distribution volume of shattered glass fragments recovered from the surrounding floor
(D) By applying Locard's exchange principle to quantify the density of chemical gunshot residue deposited around each hole

38. Concentric fractures in a broken glass pane generally occur due to tension on which side of the glass?
(A) The reverse side of the force
(B) The edges of the glass pane
(C) The same side as the applied force
(D) Concentric fractures do not occur due to tension, they occur due to compression

39. In fire and arson reconstruction, a "V-pattern" found on a wall is a critical indicator because the base (bottom point) of the "V" generally points toward:
(A) The location where firefighters entered the room
(B) The presence of multiple liquid accelerants
(C) The direction of the wind during the fire
(D) The point of origin of the fire

40. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Fire scene investigators often look for "alligatoring" patterns to definitively prove that a liquid accelerant was used.
Reason (R): Modern forensic science has established that deep, large blistered alligatoring on wood exclusively occurs when highly flammable liquid accelerants are present.
In the light of the above statements, choose the correct answer from the options given below:
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

41. The breaking away of layers of concrete at a fire scene due to the rapid expansion of moisture within the material is termed:
(A) Crazing
(B) Spalling
(C) Pyrolysis
(D) Flashover

42. Irregular, sharply defined burn patterns found on a floor surface at a fire scene, often resembling puddles, are highly suggestive of:
(A) An arcing electrical short circuit originating within the ceiling wiring
(B) The pour pattern of an ignitable liquid accelerant
(C) A natural, slow-smoldering fire involving structural timber
(D) The rapid oxygen-induced ignition effects of a backdraft event

Click Here to Buy book on Flipkart

(A) II → IV → I → III
(B) II → IV → III → I
(C) IV → II → III → I
(D) II → III → IV → I

www.nodia.in

NODIA

is a hallmark feature distinguishing which type of wound from a sharp force injury?
(A) Blunt force laceration
(B) Incised sharp force wound
(C) Penetrating stab wound
(D) Superficial hesitation cut

52. Stippling or tattooing around a gunshot wound is a critical finding for reconstructing the incident because it helps estimate the:
(A) Specific caliber of the firearm bullet used
(B) Exact time of day the shooting occurred
(C) Physical height and posture of the shooter
(D) Firing distance or range of fire

53. If a reconstruction expert determines a victim was smothered rather than manually strangled, which specific physical evidence would support smothering?
(A) A distinct linear ligature mark encircling the victim's neck
(B) Foreign pillow fibres in the airway
(C) A complete fracture of the hyoid bone structures
(D) Multiple crescent-shaped fingernail abrasion marks on the throat

54. A staged crime scene is best defined as a scene where:
(A) Multiple victims are discovered across distinct, physically separated geographic locations
(B) Forensic investigators systematically place numbered evidence markers throughout the scene layout
(C) Physical evidence is intentionally altered to misdirect the investigation
(D) The entire sequence of criminal actions was fully recorded by high-definition CCTV cameras

55. Given below are two lists. Match List I with List II.
List I: Forensic Finding
P. Disarray of drawers but valuables left untouched
Q. Gunshot wound to the temple with no weapon found nearby
R. Broken glass on top of a burglar's footprint
S. Ligature marks with an upward V-pattern
List II: Crime Scene Scenario
1. Staged burglary
2. Suicidal hanging
3. Window broken from the inside after entry (Staged)
4. Homicide staged as suicide
(A) P-1, Q-4, R-3, S-2
(B) P-3, Q-1, R-4, S-2
(C) P-1, Q-2, R-3, S-4
(D) P-4, Q-3, R-2, S-1

56. When investigating an autoerotic fatality, a scene might initially appear to be a homicide or suicide. Which of the following is a classic indicator of an accidental autoerotic death rather than a staged homicide?
(A) A self-rescue mechanism intended to allow escape from bindings
(B) A total and complete absence of any physical bindings, ligatures, or restraint ropes near the body
(C) Extensive signs of forced entry at access points combined with missing high-value personal property
(D) The presence of multiple deep, penetrating sharp force stab wounds located across the torso

57. The post-mortem interval (PMI) is essential for relational and sequence reconstruction. The pooling of blood in the dependent areas of a body due to gravity is termed:
(A) Algor mortis
(B) Livor mortis
(C) Rigor mortis
(D) Pallor mortis

NODIA

58. By examining Livor mortis, a forensic expert can often determine if a body was moved after death. Typically, livor mortis becomes fixed (will not blanch upon pressure) after approximately how many hours?
(A) 1-2 hours
(B) 4-6 hours
(C) 8-12 hours
(D) 24-36 hours

59. The estimation of time since death by measuring the drop in body temperature follows a predictable curve. This cooling process is scientifically termed:
(A) Algor mortis
(B) Livor mortis
(C) Rigor mortis
(D) Putrefaction

R. Turned-over chair near a scuffle
S. Smeared blood pattern on a wall

List II: Role in Reconstruction
1. Indicates movement or wiping action
2. Indicates the sequence of shots fired
3. Indicates the body was moved after death
4. Relational evidence indicating a struggle

(A) P-2, Q-3, R-4, S-1
(B) P-3, Q-2, R-1, S-4
(C) P-1, Q-4, R-3, S-2
(D) P-2, Q-4, R-3, S-1

76. When using a trajectory rod to reconstruct a bullet path through a car seat, what must the investigator carefully avoid?
(A) Rigorously documenting and photographing the precise dimensions of entry and exit defect holes
(B) Placing standardized forensic photographic scale markers immediately adjacent to bullet impact holes
(C) Forcing the rod through tissue/material, altering original trajectory
(D) Taking three-dimensional angular trajectory measurements using a digital protractor device

77. Which mathematical theorem is essentially applied when an investigator calculates the area of origin in 3D space by knowing the distance to the area of convergence and the angle of impact?
(A) Bernoulli's fluid dynamic principle
(B) Newton's second law of motion
(C) Locard's exchange principle
(D) Trigonometric principles

78. When analyzing a staged scene where a fire was intentionally set to cover up a homicide, which of the following findings is most critical in establishing the true sequence of events?
(A) Significant soot accumulation inside the victim's respiratory tract and lungs
(B) Thermal injury producing first-degree burns across the victim's epidermis
(C) Absence of carboxyhemoglobin in the victim's blood
(D) Thermally deformed and melted plastic materials located near the body

79. Bloodstains found on the inside of a firearm barrel, resulting from blood being drawn back into the muzzle due to the expanding gases of a close-range shot, is known as:
(A) Forward cast-off pattern
(B) Back spatter
(C) Expirated blood stain
(D) Dynamic wipe or swipe

80. Consider the following statements regarding 3D laser scanning at crime scenes:
I. It captures millions of data points to create a precise virtual 'point cloud' of the scene.
II. It entirely replaces the need for standard crime scene photography.
III. It allows investigators to take accurate measurements virtually long after the physical scene is released.
IV. It is completely immune to errors caused by reflective surfaces or bright sunlight.

Which of the above statements are correct?
(A) I and III only
(B) I, II, and III only
(C) II and IV only
(D) I, III, and IV only

81. In an accident reconstruction, what does the term "yaw" refer to?
(A) Rotation around the vertical axis causing lateral sliding
(B) The forward pitching motion of the vehicle chassis during hard braking
(C) The lateral rolling over motion of the vehicle body during an impact
(D) The vertical bouncing of the vehicle suspension system over a road bump

82. Which of the following best describes the "chain of custody" and its importance to crime scene reconstruction?
(A) The mathematical process of connecting individual bloodstain vectors to pinpoint a two-dimensional area of convergence
(B) The high-visibility physical perimeter barrier tape established by initial law enforcement officers to secure the crime scene
(C) Complete documentation tracking evidence custody and transfer to maintain integrity
(D) The strict hierarchical administrative structure of investigating law enforcement officers present on site

83. When reconstructing a crime scene involving skeletal remains, forensic anthropology plays a key role. Which bone is most commonly utilized to accurately determine the biological sex of an adult skeleton?
(A) Pelvis
(B) Femur

Downloaded from www.pdf.tube

67. Under the Bharatiya Sakshya Adhiniyam, 2023, the opinion of an expert who has reconstructed a crime scene is considered relevant. This expert testimony corresponds to which provision of the Act?
(A) Section 24
(B) Section 39
(C) Section 54
(D) Section 106

68. What is the fundamental difference between deductive and inductive reasoning in the formulation of a reconstruction hypothesis?
(A) Deductive reasoning relies exclusively on circumstantial witness statements; inductive reasoning relies entirely on physical trace evidence
(B) Deductive reasoning is legally inadmissible in court proceedings; inductive reasoning is preferred by judicial officers for reconstruction
(C) Forensic methodology recognizes no practical distinction; both terms are treated as exact synonyms during investigation
(D) Deductive applies general principles to specific facts; inductive builds general ideas from specific observations

69. During a homicide reconstruction, the investigator notes that blood has pooled around the victim's head, but there is also a distinct, dried secondary pool of blood several feet away with a drag mark connecting them. This pattern is primarily an example of:
(A) Spatial directional determination of physical objects
(B) Relational and sequence determination
(C) Environmental conditional determination at the scene
(D) Criminal intent determination of the suspect

70. Consider the following statements regarding the reconstruction of asphyxial deaths:
I. In a typical suicidal hanging, the ligature mark on the neck usually shows an inverted V-shape pointing towards the knot.
II. In manual strangulation, bruising shaped like fingertips and thumbprints is often found on the victim's neck.
III. In both hanging and strangulation, the hyoid bone is fractured in 100% of cases regardless of the victim's age.
Which of the above statement(s) is/are INCORRECT?
(A) I only
(B) II only
(C) III only
(D) I and II only

71. If an investigator uses the Glaister equation to estimate the post-mortem interval, which two variables are primarily required?
(A) Relative ambient humidity levels and total body weight
(B) Rigor mortis progression status and livor mortis coloration
(C) Local atmospheric pressure readings and geographical scene altitude
(D) Ambient and rectal body temperatures

72. Which of the following best defines "Terminal Velocity" in the context of falling blood drops?
(A) The maximum free-fall speed reached when air resistance balances gravity
(B) The initial kinetic velocity of blood droplets as they exit a high-velocity firearm barrel
(C) The minimum speed required for centrifugal force to throw blood off a swinging weapon
(D) The critical velocity threshold at which a flying blood droplet overcomes its surface tension

73. A blood droplet falling perfectly vertically (90 degrees) onto a smooth, non-porous glass surface will typically leave a stain of what shape?
(A) An elongated ellipse displaying a prominent tail
(B) Circular with smooth edges
(C) A star-shaped stain with heavy peripheral spines
(D) A symmetrical rectangular stain

74. If blood drips directly into a pre-existing pool of liquid blood, the resulting pattern is characterized by random, small satellite spatters around the main pool. This specific pattern is termed:
(A) Cast-off
(B) Drip pattern
(C) Swipe pattern
(D) Arterial spurt

NODIA

75. Given below are two lists. Match List I with List II.
List I: Evidence Type
P. Terminating glass fractures
Q. Livor mortis on the victim's back while lying on their stomach

43. In road accident reconstruction, skid marks are primarily used to calculate which of the following variables?
(A) Minimum pre-braking vehicle speed
(B) The exact time of day that the collision occurred
(C) The blood alcohol concentration of the motor vehicle driver
(D) The manufacturing year and design model of the vehicle tyres

44. To estimate the speed of a vehicle from its skid marks, an investigator must know the length of the skid marks and the:
(A) The exact make, model, and curb weight of the vehicle
(B) The total volume of fuel remaining inside the tank
(C) Road surface drag factor
(D) The precise turning angle of the vehicle steering wheel

45. Consider the following statements regarding road accident reconstruction:
I. A skid mark is produced when a wheel is locked and slides along the road surface.
II. A yaw mark is produced when a vehicle travels in a curved path faster than the tyres can handle, causing them to slip sideways.
III. Anti-lock Braking Systems (ABS) typically produce solid, unbroken, dark skid marks similar to older locked-wheel systems.
IV. The pedestrian throw distance can be utilized to estimate the impact speed of the striking vehicle.
Which of the above statements are correct?
(A) I, II, and III only
(B) I, II, and IV only
(C) II, III, and IV only
(D) I, III, and IV only

46. A vehicle accident investigator needs to measure the track width of a suspect vehicle. This measurement is taken from:
(A) The distance measured from the center line of the front axle to the center line of the rear axle
(B) The distance from the foremost point of the front bumper to the rearmost point of the rear bumper
(C) Center of right tyre tread to center of left tyre tread on an axle
(D) The width measured from the inner edge of a tyre to the outer edge of that same individual tyre

47. In reconstructing the path of a vehicle from tyre prints left in soft soil, which feature helps determine the direction of travel?
(A) The total measured depth of the tyre track impression in soil
(B) Orientation of crushed vegetation
(C) The total wheelbase length between the front and rear axles
(D) The specific brand name molded onto the tyre sidewall rubber

48. When reconstructing a suspect's movements based on footwear prints, the distance measured from the center of the heel of one footprint to the center of the heel of the next opposite footprint is defined as the:
(A) Stride length
(B) Track width
(C) Foot angle
(D) Step length

49. In forensic pathology and reconstruction, the presence of numerous shallow, superficial cuts on a victim's wrists or neck alongside a fatal incised wound is strongly indicative of:
(A) Suicidal hesitation marks
(B) A physical homicidal struggle against an armed assailant
(C) Accidental sharp trauma resulting from shattered glass
(D) Post-mortem tissue mutilation caused by scavenging animals

50. Consider the following statements regarding wound patterns and reconstruction:
I. Defense wounds are typically found on the hands, forearms, or lower legs of a victim who attempted to ward off an attack.
II. An incised wound is characteristically longer than it is deep and does not show tissue bridging.
III. A laceration is caused by a sharp-edged weapon like a razor blade and has cleanly divided margins.
Which of the above statements is/are correct?
(A) I and II only
(B) I and III only
(C) II and III only
(D) I, II, and III

51. The phenomenon of "tissue bridging" (intact nerves and blood vessels crossing the wound gap)

Click Here to Buy book on Amazon

(C) Tibia
(D) Radius

84. A crime scene investigator finds a suspect's shoe print pressed deeply into mud. What is the most appropriate initial method of recording this 3D impression before casting?
(A) Immediately pouring dental stone or plaster of Paris without taking initial scale photos
(B) Fuming the impression heavily with cyanoacrylate ester vapors to harden the fragile soil
(C) Carefully excavating the surrounding soil matrix with a shovel and transferring it to a bag
(D) Photographing with a scale under oblique lighting

85. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Crime scene reconstruction cannot always definitively determine every single action that occurred during a crime.
Reason (R): Missing evidence, subjective interpretation, and the dynamic nature of crimes create limitations in the reconstruction process.
In the light of the above statements, choose the correct answer from the options given below:
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

86. When analyzing glass fragments from a hit-and-run accident for relational reconstruction, finding a physical match (jigsaw fit) between a piece of glass at the scene and the broken headlight of a suspect's car is classified as:
(A) Class characteristic evidence
(B) Transient environmental evidence
(C) Individual evidence
(D) Conditional scene evidence

87. In a room where a brutal bludgeoning occurred, an investigator notices a rectangular patch on the wall that is completely free of blood spatter, despite heavy spatter all around it. The floor beneath this patch is also free of spatter. This pattern most strongly indicates:
(A) The blunt or sharp assault weapon was thoroughly wiped clean of blood prior to police arrival
(B) The perpetrator stood directly against that specific section of the wall, blocking all blood spatter
(C) Airborne blood droplets evaporated rapidly in mid-flight before reaching the vertical wall surface
(D) An object was present during the attack and later removed

NODIA

88. Given below are two lists. Match List I with List II.
List I: Forensic Tool / Concept
P. BackTrack software
Q. Plumb bob and protractor
R. Glaister equation
S. Coefficient of friction
List II: Reconstruction Application
1. Vehicle accident speed estimation
2. Post-mortem interval calculation
3. Bloodstain trajectory analysis
4. Firearm bullet trajectory measurement
(A) P-3, Q-4, R-2, S-1
(B) P-4, Q-3, R-1, S-2
(C) P-3, Q-1, R-4, S-2
(D) P-1, Q-2, R-3, S-4

89. An investigator seeks to map the trajectory of a bullet that passed completely through a victim's body. What is the primary limitation of using wound tracks in a human body for precise trajectory reconstruction?
(A) Medico-legal protocols strictly prohibit taking trajectory photographs during an autopsy examination
(B) Body posture and internal organs shift, altering wound track alignment
(C) Projectile trajectories remain in perfectly straight, undeviated lines regardless of internal anatomical structures
(D) Inserting a metal or fiberglass trajectory rod will inevitably destroy all micro-traces of gunshot residue

90. Arrange the following actions in the logical order of processing and reconstructing a major crime scene:
I. Perform final survey and release the scene.
II. Secure and isolate the crime scene.
III. Formulate a reconstruction hypothesis based on lab results and scene data.
IV. Document the scene (photography, sketching, notes) and collect physical evidence.
Choose the correct option:

9. (B) It eliminates hypotheses contradicted by the physical evidence at the scene
Falsification is a core concept in the scientific method applied to forensic reconstruction. By actively attempting to disprove or falsify proposed hypotheses, investigators can systematically eliminate explanations that conflict with physical evidence. Disproving invalid scenarios narrows the range of possibilities, leaving only scientifically supported interpretations that align with physical facts.

10. (B) Discrepancies between physical evidence and reported events
A staged crime scene occurs when physical evidence is intentionally manipulated to mislead investigators regarding the true nature or sequence of events. Identifying staging relies fundamentally on discovering physical discrepancies, such as incompatible bloodstain patterns, unnatural injury orientations, or conflicting entry points that contradict reported accounts or common environmental logic.

11. (A) Surface tension
Surface tension is the cohesive force governing liquid drops that pulls molecules inward toward the center, creating a sphere with minimal surface area. When blood travels through the air as a free-falling droplet, surface tension maintains its spherical shape until it strikes an external target surface, resisting physical deformation during flight.

12. (C) Drip pattern
Passive bloodstains are formed exclusively by the force of gravity acting upon liquid blood without external physical energy or pressure. A drip pattern occurs when blood drops fall vertically into a liquid pool or onto a surface purely under gravitational acceleration, distinguishing passive stains from projected, impact, or cast-off bloodstain categories.

13. (D) The movement of a bloodied body or object relative to gravity after deposition
Flow patterns are bloodstain features formed by gravity acting on liquid blood deposited on a surface. The direction and morphology of flow lines reveal whether a surface, body, or object changed position after initial blood deposition. Discrepancies in flow direction provide critical evidence regarding post-mortem movement or manipulation of scene evidence.

14. (B) I, II, and IV only
Pool patterns result from blood accumulating on level surfaces, skeletonization leaves an outer rim when drying occurs before disruption, and void patterns identify intervening objects blocking spatter deposition. High-velocity impact spatter produces fine droplets smaller than one millimeter in diameter, making the statement claiming droplets larger than five millimeters scientifically incorrect.

15. (B) Transfer pattern
A transfer pattern is created when a wet, blood-bearing surface comes into direct physical contact with another surface. Characteristics of the contact object, such as ridge details, footwear tread design, or fabric textures, may be transferred onto the receiving target surface, providing crucial physical evidence for identifying involved objects or individuals.

16. (D) A swipe transfers blood from a bloody object onto a clean surface; a wipe moves an object through an existing stain
A swipe pattern occurs when a bloodied object moves across an unstained surface, transferring blood along the motion path. Conversely, a wipe pattern is created when an unstained or secondary object moves through a pre-existing, wet bloodstain on a target surface, altering its original structure and dragging blood along the path.

17. (A) High-velocity impact (e.g., gunshot wound)
High-velocity impact spatter is produced when high physical energy, typically exceeding one hundred feet per second, acts upon a liquid blood source. Explosive forces or firearm projectiles atomize blood, creating fine mist-like spray patterns composed of micro-droplets measuring less than one millimeter in diameter that travel brief distances through the air.

18. (C) The minimum number of blows struck
Cast-off bloodstain patterns are formed when blood is flung from a moving blood-bearing object, such as a blunt weapon or sharp instrument. Because the initial strike accumulates blood on the weapon and subsequent swings release linear stain tracks, analyzing distinct cast-off tracks enables investigators to establish the minimum number of blows delivered.

Downloaded from www.pdf.tube

ANSWERS

1. (A) To determine the sequence of events and actions that occurred during the crime
Crime scene reconstruction is a forensic approach aimed at establishing the chronological sequence of events, activities, and actions that transpired during the commission of an offense. By analyzing physical evidence, spatial relationships, and bloodstain or ballistic patterns, forensic investigators scientifically deduce what occurred before, during, and after the criminal event to provide an objective factual account.

2. (C) Re-enactment involves individuals acting out a hypothesized version of events, while reconstruction relies strictly on scientific analysis of physical evidence to determine what occurred
Crime scene re-enactment relies on live actors or participants physically performing actions based on hypotheses, witness testimony, or assumptions regarding an event. In contrast, crime scene reconstruction is an objective, scientific process. It relies solely on the rigorous evaluation, testing, and interpretation of physical trace evidence to systematically establish the precise sequence of facts.

3. (A) Establishing the physical position and orientation of objects and individuals relative to one another
Relational reconstruction evaluates the geometric positioning, orientation, and spatial arrangement of physical items, evidence, and individuals present at a crime scene. Investigators utilize spatial mapping, baseline measurements, and trigonometric calculations to determine how bodies, weapons, and surrounding objects interacted with each other in physical space during the commission of a crime.

4. (D) Sequence determination
Sequence determination is a specialized aspect of reconstruction that determines the temporal order of events during a crime. Forensic experts analyze overlapping physical evidence, such as intersecting glass fracture lines or superimposed bloodstains, to establish which physical event occurred first and which occurred subsequently, thereby providing a clear chronological timeline of actions.

5. (B) Data collection → Hypothesis formation → Testing and verification → Conclusion
Applying the scientific method to crime scene reconstruction requires a systematic multi-step workflow. Investigators begin by gathering all available physical evidence and scene data. Next, they formulate plausible hypotheses explaining the events. These hypotheses are rigorously subjected to empirical testing and physical verification. Finally, logical conclusions are established based exclusively on verified results.

6. (C) The state of the lights (on or off) in a room at the time of discovery
Conditional evidence provides critical context regarding environmental or operational settings present at a crime scene when discovery occurs. Examples include light switch positions, room temperature, door locks, or window states. This evidence is temporary or easily altered, making immediate documentation essential to reconstruct conditions existing at the exact time the crime transpired.

7. (D) By linking a suspect to the scene or victim through transferred physical trace evidence
Locard's Exchange Principle states that whenever two objects come into physical contact, a cross-transfer of trace evidence occurs. In reconstruction, this foundational principle is applied to establish physical links between a suspect, victim, and crime scene by identifying transferred materials such as microscopic fibers, soil particles, biological hair, or chemical residues.

8. (C) I and III only
Reconstruction begins with comprehensive data collection, capturing all physical evidence and spatial scene details. Formulated hypotheses must then be rigorously tested against verified physical evidence to identify discrepancies. Ignoring witness statements during hypothesis formation is unscientific; investigators must evaluate witness statements alongside physical data, rather than ignoring them, to achieve unbiased results.

NODIA

60. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Forensic entomology can be used in reconstruction to estimate the post-mortem interval.
Reason (R): Different species of necrophagous insects colonize a dead body in a predictable succession pattern over time.
In the light of the above statements, choose the correct answer from the options given below:
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

61. Modern crime scene reconstruction frequently uses a technology called LIDAR. What does LIDAR stand for?
(A) Light Imaging Detection And Recording
(B) Laser Improvised Distance And Ranging
(C) Latent Image Development And Reconstruction
(D) Light Detection And Ranging

62. Which of the following best describes the process of photogrammetry in crime scene reconstruction?
(A) Recovering deleted or corrupted digital photographs from a suspect's confiscated camera storage
(B) Enhancing blurred low-resolution CCTV surveillance video footage captured at a crime scene
(C) Deriving accurate 3D spatial measurements from 2D photographs
(D) Utilizing specialized chemical developers to fix silver halide latent images on photographic paper

63. When presenting 3D computer models in court for reconstruction purposes, what is the primary legal distinction between an "animation" and a "simulation"?
(A) An animation is admissible only when prepared by the prosecution, whereas a simulation is exclusive to defense counsel
(B) An animation illustrates testimony, while a simulation uses data to compute outcomes
(C) An animation is legally restricted to jury trials, whereas a simulation is utilized exclusively during bench proceedings
(D) Modern evidentiary law recognizes no formal distinction; the two legal terms are fully interchangeable in court

64. A Total Station is an instrument frequently used by forensic investigators at outdoor crime scenes. What is its primary function?
(A) To rapidly detect volatile organic chemical compounds emitted by ignitable liquid arson accelerants
(B) To extract and determine the short tandem repeat genetic profile of trace blood evidence directly on site
(C) To project visible alignment laser trajectories across open scenes for ballistic flight path analysis
(D) To electronically measure angles and distances to map crime scenes

65. Choose the correct sequence of steps for casting a three-dimensional footwear impression at a crime scene:
(A) Clean out loose debris → Spray fixing agent (if soil is fragile) → Prepare dental stone mixture → Pour mixture into impression → Allow to set
(B) Prepare dental stone mixture → Pour into impression → Clean out loose debris → Spray fixing agent → Allow to set
(C) Spray fixing agent → Clean out loose debris → Pour water → Add dental stone powder → Allow to set
(D) Pour mixture into impression → Allow to set → Clean out loose debris → Spray fixing agent

66. A primary limitation of crime scene reconstruction is that it relies entirely on the evidence collected. If the initial responders alter the scene before documentation, what is the most likely consequence for reconstruction?
(A) Forensic reconstruction software programs will automatically detect and correct initial scene errors
(B) Investigators are forced to discard physical evidence and rely entirely on subjective witness statements
(C) The reconstruction may be flawed from inaccurate data
(D) The scene disturbance affects conditional evidence while leaving relational spatial evidence intact

Click Here to Buy book on Flipkart

19. (A) Pulsating or wave-like stain patterns matching heart contractions
Arterial spurt or gush patterns are created when a major artery is damaged, releasing blood under hydraulic pressure generated by cardiac contractions. This mechanism produces characteristic wave-like or pulsating bloodstain patterns across surrounding surfaces, featuring large volume deposits, vertical spikes, and downward flows that directly reflect active heartbeats.

20. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Expirated blood patterns originate when blood forced from the airway or lungs is propelled by exhaled air pressure. This process atomizes blood into extremely tiny droplets that mimic high-velocity impact spatter. Because both mechanisms produce fine mist-like drops, expirated blood patterns can easily be confused with gunshot impact spatter during initial visual examination.

21. (B) The presence of air bubbles in the bloodstains and dilution from saliva
Differentiating expirated blood from impact spatter requires identifying distinct biological and physical features. Because expirated blood is forcefully expelled from the respiratory system, the resulting droplets frequently exhibit trapped air bubbles that leave circular ring voids, as well as color dilution caused by salivary fluids and respiratory mucus.

22. (C) The location of an object or person present during bloodshed but later moved
A void pattern is an empty area within an otherwise continuous bloodstain pattern. It occurs when an intervening object, victim, or perpetrator blocks blood spatter from reaching the surface behind it. When the blocking entity is removed, the outline left behind identifies its spatial orientation and presence during the bleeding event.

23. (D) $\sin(\theta) = W / L$
The mathematical angle of impact for a blood drop is calculated using trigonometric functions based on stain measurements. The sine of the impact angle equals the width of the bloodstain divided by its length. Taking the inverse sine of this ratio yields the exact impact angle in degrees relative to the target surface.

24. (B) 30 degrees
The impact angle of a blood droplet is determined mathematically using the formula $\sin(\theta) = \text{Width} / \text{Length}$. Dividing a width of five millimeters by a length of ten millimeters yields a sine ratio of zero point five. Calculating the arcsine of zero point five provides an estimated impact angle of thirty degrees.

25. (A) P-2, Q-1, R-4, S-3
Cast-off patterns result from blood flung off moving objects. The area of convergence represents the two-dimensional intersection point of lines projected along the long axes of bloodstains. Skeletonization occurs when dried outer edges remain after a stain's center is wiped, while transfer patterns form when wet bloodied surfaces make physical contact with secondary targets.

26. (B) Area of origin
The area of origin defines the three-dimensional location in space from which blood was projected or spatters originated during an impact event. It incorporates both the two-dimensional convergence point on a planar surface and the calculated spatial height above that point, enabling reconstruction of the exact physical position of the blood source.

27. (A) Stringing method
The stringing method is a classic manual technique used to establish the three-dimensional area of origin of blood spatters. Investigators secure physical strings along the long axes of individual bloodstains at their calculated impact angles. The point in three-dimensional space where these strings converge indicates the spatial position of the blood source.

28. (C) Angle of impact
Calculating the height of the area of origin using the tangent trigonometric function requires two primary values. Investigators must measure the linear distance from individual bloodstains to the two-dimensional area of convergence, and calculate each stain's angle of impact. Multiplying the distance by the tangent of the impact angle provides the spatial height.

29. (D) Automate 3D area of convergence and origin calculations from digital images
Dedicated bloodstain analysis software programs, including Hemospat and BackTrack,

Downloaded from www.pdf.tube

50. (A) I and II only
Defense wounds occur on hands or forearms during active self-defense, and incised wounds are longer than deep with clean edges and no tissue bridging. Lacerations are caused by blunt force crushing and tearing skin, displaying irregular margins and tissue bridging, making the third statement regarding lacerations scientifically false.

51. (A) Blunt force laceration
Tissue bridging refers to intact blood vessels, nerve fibers, and connective strands spanning across a wound gap. This key feature occurs during blunt force lacerations where skin tears under crushing tension, reliably distinguishing blunt force lacerations from sharp force injuries like incised wounds that cleanly sever all soft tissue structures.

52. (D) Firing distance or range of fire
Powder stippling or tattooing consists of pinpoint abrasion marks caused when unburned or partially burned gunpowder granules strike skin around an entrance wound. Because gunpowder particles disperse predictably across space, analyzing the diameter and density of stippling provides an reliable forensic basis for estimating muzzle-to-target firing distance.

53. (B) Foreign pillow fibres in the airway
Smothering is a form of asphyxia caused by external mechanical occlusion of the external nose and mouth. Finding foreign textile fibers, such as cotton or synthetic pillow fibers, deep within the nasal passages or upper airway provides strong physical evidence that a soft object was forcefully pressed over the face.

54. (C) Physical evidence is intentionally altered to misdirect the investigation
A staged crime scene occurs when a perpetrator or interested individual intentionally manipulates, alters, or moves physical evidence after an offense has been committed. The main objective of staging is to misdirect criminal investigation, conceal true criminal motives, or simulate an entirely different crime, such as presenting homicide as suicide.

55. (A) P-1, Q-4, R-3, S-2
Disarray with untouched valuables suggests staged burglary. A fatal gunshot wound without a firearm indicates homicide staged as suicide. Glass fragments resting on top of a suspect footprint prove the window was broken after entry, indicating staging. Ligature marks slanting upward in an inverted V-shape are classic findings in suicidal hanging.

56. (A) A self-rescue mechanism intended to allow escape from bindings
Autoerotic fatalities are accidental deaths occurring during solitary asphyxial sexual practices. A key feature distinguishing these accidental deaths from staged homicides is the presence of intentional self-rescue mechanisms, such as quick-release knots, protective neck padding, or accessible release cords designed by the decedent to maintain personal control and escape.

NODIA

57. (B) Livor mortis
Livor mortis, or post-mortem lividity, describes the physical pooling of blood in lower dependent body areas under gravity following cardiac arrest. This process causes purplish skin discoloration in non-compressed skin regions, providing forensic investigators with essential physical evidence regarding post-mortem timeframes and determining whether a body was relocated after death.

58. (C) 8-12 hours
Livor mortis begins within one to two hours after death and deepens progressively. Over time, red blood cells break down and pigment diffuses into surrounding soft tissues, causing lividity to become permanently fixed around eight to twelve hours post-mortem. After fixing occurs, pressing firmly on the skin will no longer produce blanching.

59. (A) Algor mortis
Algor mortis refers to the post-mortem cooling process in which a human body undergoes thermal equalization with its surrounding ambient environment. Following death, heat production ceases and internal body temperature drops at a predictable rate, allowing forensic pathologists to estimate the post-mortem interval based on temperature measurements and environmental variables.

60. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Forensic entomology applies insect science to legal death investigations for estimating time

39. (D) The point of origin of the fire
Thermal convection causes heat, smoke, and hot gases during a structural fire to rise upward and spread outward, forming a characteristic V-shaped burn pattern on vertical walls or surfaces. The apex or bottom point of this V-pattern narrows directly toward the initial point of origin where the fire initially ignited.

40. (D) Assertion (A) is false but Reason (R) is true.
Alligatoring refers to blistering patterns appearing on charred wood after fire exposure. Historically thought to indicate accelerants, modern fire science proves that large, deep blisters occur naturally in high-intensity fires regardless of accelerant presence. Because alligatoring cannot conclusively prove liquid accelerant use, claiming it provides definitive proof is scientifically false.

41. (B) Spalling
Spalling describes the fracturing, flaking, or breaking away of concrete layers caused by intense heat during a fire. Moisture trapped inside porous concrete matrix converts rapidly into steam, generating high internal pressure. When steam expansion exceeds the structural strength of concrete, surface layers violently fracture and pop off.

42. (B) The pour pattern of an ignitable liquid accelerant
Irregular, sharply defined burn patterns featuring curved, puddle-shaped borders on flooring surfaces are characteristic indicators of ignitable liquid accelerants. Flammable liquids poured onto a floor pool in localized low areas, burning downward into structural materials and leaving distinct, irregularly shaped burn marks that mirror the original liquid layout.

43. (A) Minimum pre-braking vehicle speed
In accident reconstruction, skid marks form when locked tires slide across pavement, generating friction that converts kinetic energy into heat and rubber friction marks. By measuring total continuous skid mark length, forensic investigators apply physics equations to calculate the minimum pre-braking speed required for the vehicle to produce those marks.

44. (C) Road surface drag factor
Mathematical estimation of vehicle speed using skid mark length relies on the standard drag formula derived from kinetic energy principles. Beyond measuring total skid distance, investigators must establish the road surface drag factor or coefficient of friction, which quantifies frictional resistance between sliding tire rubber and specific road surface materials.

45. (B) I, II, and IV only
Skid marks are generated by locked sliding wheels, yaw marks occur during lateral cornering slips, and pedestrian throw distance helps estimate vehicle impact velocity. Anti-lock Braking Systems prevent full wheel lockup by pulsing brakes, producing light or faint scuffs rather than dark continuous skid marks, rendering the third statement false.

46. (C) Center of right tyre tread to center of left tyre tread on an axle
In vehicle reconstruction, track width or track gauge is defined as the physical distance measured between the center line of the right tire tread and the center line of the left tire tread on a single axle. This metric helps match tire impressions found at a scene to specific vehicle types.

47. (B) Orientation of crushed vegetation
Determining a vehicle's travel direction through soft soil involves examining directional physical deformation signatures. As vehicle tires roll forward across soft vegetation, plant stalks are crushed and bent forward in the vehicle's direction of movement. Soil displaced from tire tread grooves is pushed backward, confirming the directional movement path.

48. (D) Step length
In gait analysis and footwear reconstruction, step length is defined as the distance measured between corresponding points of two consecutive footprint impressions, specifically from the center of one heel to the center of the opposite heel. This measurement differs from stride length, which measures the distance between consecutive impressions of the same foot.

49. (A) Suicidal hesitation marks
Hesitation marks are shallow, superficial incised cuts produced adjacent to a main fatal wound, commonly on the wrists or neck. They reflect initial tentative attempts made by an individual prior to inflicting the final lethal injury, serving as a classical medico-legal indicator of self-inflicted suicidal trauma in forensic death investigations.

Click Here to Buy book on Amazon

examinations rarely mirrors the exact anatomical orientation existing at impact.

90. (A) II → IV → I → III
Scene processing and reconstruction follow an established operational sequence. First, first responders secure and isolate the crime scene. Second, investigators document the scene and collect physical evidence. Third, a final survey is conducted before releasing the scene. Fourth, laboratory results and documented evidence are integrated to formulate scientific reconstruction hypotheses.

www.nodia.in

NODIA

since death. Necrophagous insects colonize decomposing bodies in predictable, orderly succession waves influenced by environmental conditions. By analyzing larval growth rates and insect species succession, forensic entomologists determine the minimum post-mortem interval with high scientific accuracy.

61. (D) Light Detection And Ranging
LIDAR stands for Light Detection And Ranging. It is an optical remote sensing technology that uses rapidly pulsed laser beams to accurately measure distances to physical targets. In forensic crime scene reconstruction, LIDAR scanners collect millions of spatial data points to create high-resolution, three-dimensional digital point clouds of entire scenes.

62. (C) Deriving accurate 3D spatial measurements from 2D photographs
Photogrammetry is the technique of extracting reliable geometric measurements and physical spatial coordinates from two-dimensional photographs. By mathematically analyzing overlapping photographs taken from varying vantage points with scale calibration markers, forensic specialists construct scaled three-dimensional computer models of crime scenes and complex evidence without physically disturbing any original scene conditions.

63. (B) An animation illustrates testimony, while a simulation uses data to compute outcomes
In courtroom evidentiary presentation, an animation is a demonstrative visual aid created to illustrate witness testimony or expert opinion without performing physics calculations. In contrast, a simulation is a computer model that applies physical laws, formulas, and empirical data to independently calculate and predict physical outcomes or vehicle motion paths.

64. (D) To electronically measure angles and distances to map crime scenes
A Total Station is an electronic optical surveying instrument combining an electronic theodolite with an electronic distance meter. Forensic investigators use Total Stations at indoor and outdoor scenes to measure precise horizontal angles, vertical angles, and slope distances, allowing creation of highly accurate two-dimensional and three-dimensional crime scene maps and diagrams.

65. (A) Clean out loose debris → Spray fixing agent (if soil is fragile) → Prepare dental stone mixture → Pour mixture into impression → Allow to set
Casting three-dimensional footwear impressions requires careful systematic preparation. Loose debris inside the impression is removed without disturbing fine tread details. Fragile soil is stabilized using aerosol fixing spray. Dental stone mixture is then prepared, poured gently into the impression, and left undisturbed to harden fully before safe excavation and removal.

66. (C) The reconstruction may be flawed from inaccurate data
Crime scene reconstruction depends on the integrity, context, and spatial position of physical evidence documented at the scene. If first responders alter, displace, or contaminate evidence prior to documentation and mapping, the resulting data collected becomes compromised, leading to flawed analytical premises, erroneous hypotheses, and inaccurate overall forensic conclusions.

67. (B) Section 39
Under the Bharatiya Sakshya Adhiniyam, 2023, Section 39 governs the relevancy of expert opinions. When courts form an opinion upon points of science, art, technical fields, or specialized disciplines like crime scene reconstruction, opinions expressed by qualified experts possessing specialized knowledge and practical training are deemed relevant legal expert evidence.

68. (D) Deductive applies general principles to specific facts; inductive builds general ideas from specific observations
Deductive reasoning applies established physical principles, laws of science, and general premises to specific facts collected at a scene, yielding logically sound conclusions. In contrast, inductive reasoning moves from specific observed physical evidence to synthesize broader generalized theories, serving as a tool for forming initial investigative hypotheses during forensic reconstruction.

69. (B) Relational and sequence determination
Observing a primary pool of blood around the head, a secondary blood pool nearby, and a connecting drag mark demonstrates both relational and sequential dynamics. This physical evidence establishes spatial movement between

Downloaded from www.pdf.tube

probative value than testimonial evidence because it is objective and cannot perjure itself.

II. The probative value of class evidence increases when multiple different types of class evidence independently corroborate the same sequence of events.

III. Physical evidence alone is always legally sufficient to secure a conviction without any supporting context or chain of custody.

Which of the given statements is/are correct?

(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

9. Evidence that tends to prove a suspect's innocence or clear them of blame is termed:

(A) Inculpatory evidence
(B) Corroborative evidence
(C) Circumstantial evidence
(D) Exculpatory evidence

10. When suspect A's hair is found on suspect B's jacket, and suspect B subsequently leaves suspect A's hair on the victim's sofa during a struggle, the transfer of suspect A's hair to the sofa is known as:

(A) Primary transfer
(B) Secondary transfer
(C) Tertiary exchange
(D) Direct Locard exchange

11. Which of the following best defines "transient evidence"?

(A) Evidence that remains stable indefinitely under standard laboratory storage without requiring special preservation techniques.
(B) Evidence that is temporary and easily lost or changed, such as crime scene odours, smoke, or ambient temperatures.
(C) Evidence that requires advanced instrumental analysis and specialized chemical reagents to be detected by forensic examiners.
(D) Evidence that conclusively establishes the exact personal identity of the perpetrator without requiring contextual support.

12. Match the categories of physical evidence in List I with their appropriate examples in List II.

List I: (Categories of Physical Evidence)

P. Transient Evidence
Q. Conditional Evidence
R. Pattern Evidence
S. Trace Evidence

List II: (Examples)

1. Blood spatter distribution
2. Microscopic synthetic fibres
3. Smell of burnt explosives
4. The radio playing loudly when officers arrived

(A) P-3, Q-4, R-1, S-2
(B) P-4, Q-3, R-2, S-1
(C) P-3, Q-1, R-4, S-2
(D) P-1, Q-4, R-3, S-2

13. Associative evidence in a forensic investigation is primarily used to:

(A) Link a suspect to a crime scene or a victim.
(B) Reconstruct the sequential events of a crime.
(C) Demonstrate the exact time of death.
(D) Prove that a crime was committed.

NODIA

14. In the context of a forensic investigation, the "value of negative evidence" refers to:

(A) Physical or biological evidence that has been completely degraded or destroyed due to adverse environmental conditions at the scene.
(B) Physical evidence recovered during an investigation that primarily incriminates the victim rather than the primary suspect.
(C) The absence of expected physical evidence, which can be just as significant as its presence in proving or disproving a fact.
(D) Physical evidence that yields completely inconclusive or ambiguous laboratory test results despite repeated analytical testing.

15. The concept of "corpus delicti" evidence refers to:

(A) Physical evidence that conclusively links multiple distinct crime scenes to a single unidentified perpetrator.
(B) Forensic evidence that specifically identifies the exact weapon or tool used in the commission of an offense.
(C) The physical, deceased body of a murder victim recovered directly from the primary scene of the crime.
(D) Evidence demonstrating that a crime has actually occurred, such as a broken window in a burglary.

16. Which of the following is an example of reconstructive evidence?

(A) A voluntary judicial confession recorded by a magistrate following strict statutory

80. (A) I and III only
3D laser scanning captures millions of coordinates creating a virtual point cloud that allows accurate spatial measurements long after scene release. However, it does not replace standard forensic photography because visual color and surface texture detail are required, nor is it immune to laser reflections or direct bright sunlight interference.

81. (A) Rotation around the vertical axis causing lateral sliding
In vehicle accident reconstruction, yaw describes a rotational vehicle movement around its vertical center axis, causing tires to slip sideways relative to the direction of travel. Yaw occurs when cornering forces exceed available tire grip, generating characteristic curved yaw marks on pavement that exhibit distinct lateral tire tread scuff striations.

82. (C) Complete documentation tracking evidence custody and transfer to maintain integrity
The chain of custody is an unbroken chronological documentation process that tracks the collection, custody, control, transfer, analysis, and disposition of physical evidence. Maintaining a rigorous chain of custody ensures legal admissibility, prevents evidence tampering or contamination, and verifies that evidence evaluated during reconstruction represents original scene physical items.

83. (A) Pelvis
In forensic anthropology, the pelvic girdle is the most sexually dimorphic structure in the adult human skeleton. Anatomical features such as subpubic angle width, sciatic notch breadth, pelvic inlet shape, and pubic bone dimensions reflect functional adaptations for childbirth, providing forensic experts with high scientific accuracy when estimating biological sex.

84. (D) Photographing with a scale under oblique lighting
Prior to applying casting materials to three-dimensional impression evidence in soil, the impression must be thoroughly recorded through forensic photography. Investigators place a calibrated scale parallel to the impression and take photographs under oblique side-lighting to highlight fine shadow details, ensuring full visual preservation before physical casting.

85. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Crime scene reconstruction faces inherent scientific limitations because analysis depends entirely on physical evidence preserved and collected. Missing evidence, subjective interpretation of complex variables, unpredictable human behavior, and post-incident scene contamination create gaps in data, making it impossible for reconstruction to conclusively identify every single action that transpired during a crime.

86. (C) Individual evidence
Achieving a physical fracture match, or jigsaw fit, between broken glass fragments recovered at a scene and a broken light on a suspect vehicle establishes individual characteristic evidence. Because random irregular fracture surfaces match exclusively along microscopic cleavage margins, physical fracture matches link evidence uniquely to one single source to the exclusion of all others.

87. (D) An object was present during the attack and later removed
An unspattered rectangular area on a blood-spattered wall, paired with a matching clean floor region below, represents a classic void pattern. This physical finding indicates that an intervening object, such as a picture frame, piece of furniture, or wall hanging, was present during the assault to block spatter and subsequently removed.

88. (A) P-3, Q-4, R-2, S-1
BackTrack software automates bloodstain trajectory calculations. Plumb bobs and protractors measure bullet flight angles in trajectory analysis. The Glaister equation is a formula applied to calculate post-mortem intervals, while the coefficient of friction quantifies tire drag resistance used in vehicle accident speed estimation models during accident scene reconstruction.

89. (B) Body posture and internal organs shift, altering wound track alignment
Utilizing internal body wound tracks for precise bullet trajectory reconstruction presents inherent limitations. Soft human tissues, muscles, and internal visceral organs shift significantly depending on body posture, arm position, and spatial orientation during impact. Consequently, track alignment during post-mortem autopsy

Click Here to Buy book on Flipkart

utilize advanced computational algorithms to process calibrated digital photographs of bloodstains. By automatically extracting stain dimensions, calculating individual angles of impact, and projecting vector paths, these software tools rapidly determine spatial areas of convergence and origin with high precision and reproducibility.

30. (B) I and III only
The pointed tail of an elliptical bloodstain consistently points toward its direction of motion. Furthermore, blood drops impacting perpendicular surfaces at ninety degrees form circular stains. Satellite spatters and scalloped edges form predominantly on the leading side pointing in the direction of travel, making the second statement scientifically incorrect regarding directionality.

31. (B) Two
Mathematically determining a bullet's precise trajectory in three-dimensional space requires defining a straight line, which requires a minimum of two fixed spatial reference points. These reference points are typically created when a single projectile passes sequentially through two intermediate targets, such as an entry hole and exit hole in structural barriers or vehicle panels.

32. (D) Laser-equipped trajectory rods
Laser-equipped trajectory rods are standard forensic instruments used to visualize and reconstruct bullet paths across extensive indoor or outdoor crime scenes. By inserting rigid rods through impact holes or defects and mounting specialized laser modules, investigators project highly visible, precise linear light paths that illuminate spatial bullet trajectories and shooter positions.

33. (A) Ricochet
A ricochet occurs when a moving bullet strikes a surface or object at a low, glancing angle without penetrating fully, deflecting and continuing along a modified trajectory path. Ricochet marks exhibit distinct physical signatures on impact surfaces, providing valuable evidence for determining projectile angles, flight directions, and spatial shooting setups.

34. (C) The exit side exhibits wider beveling and cratering from glass cone displacement
When a high-velocity bullet impacts a glass pane, force propagates outward in a conical shape, displacing glass material and forming a characteristic crater. The entry side displays a relatively clean, smooth opening, whereas the exit side exhibits wider cone beveling, extensive chipping, and pronounced surface cratering.

35. (B) II → III → I → IV
Reconstructing bloodstains using the stringing method follows a strict sequential protocol. Investigators first calculate the angle of impact for representative bloodstains. Second, they determine the two-dimensional area of convergence on target surfaces. Third, strings are attached and extended at calculated angles. Finally, the three-dimensional spatial intersection point is identified as the origin.

36. (D) The side opposite to the force (Reverse side)
The 3R rule states that Radial fractures form Right angles on the Reverse side of the applied force. When glass experiences impact bending, tension builds on the side opposite the force (reverse side), initiating radial cracks that propagate outward and exhibit characteristic perpendicular right-angle stress fractures on that reverse surface.

37. (B) Fracture lines from subsequent shots terminate at pre-existing fracture lines
Determining the chronological sequence of multiple firearm impacts in glass relies on fracture propagation dynamics. Radial fractures generated by an initial bullet travel outward until structural stress dissipates. Radial fractures produced by subsequent impacts propagate outward until they encounter and terminate at existing fracture lines, establishing the clear temporal order of shots.

NODIA

38. (C) The same side as the applied force
Concentric fractures in glass are circular cracks connecting radial fracture lines. When an impacting force strikes glass, the material flexes outward, causing tensile stress to build on the front side around the impact point. Consequently, concentric fractures break due to tension occurring on the same side where the force was applied.

CHAPTER 09
Types of Evidence: An Overview

1. Which of the following best defines "evidence" in the context of forensic science and criminal law?
(A) Only the physical objects recovered from a crime scene that directly establish a suspect's presence.
(B) Information, physical items, or testimony legally submitted to a competent tribunal as a means of ascertaining the truth of any alleged matter of fact.
(C) Any item that conclusively proves the guilt of a suspect without the need for corroboration.
(D) The written findings of a forensic expert presented before a judicial magistrate.

2. An eyewitness account of a crime taking place is primarily classified as which type of evidence?
(A) Circumstantial evidence
(B) Demonstrative evidence
(C) Hearsay evidence
(D) Direct evidence

3. What is the fundamental difference between direct evidence and circumstantial evidence?
(A) Direct evidence establishes a fact directly without needing an inference, while circumstantial evidence requires an inference to connect it to a conclusion of fact.
(B) Direct evidence relies on physical objects, while circumstantial evidence relies on documents.
(C) Direct evidence requires the trier of fact to draw an inference, while circumstantial evidence does not.
(D) Direct evidence is always admissible in court, whereas circumstantial evidence is inadmissible in serious crimes.

4. In forensic science, physical evidence is defined as:
(A) Only items of biological origin found at a crime scene.
(B) The psychological profiling of the suspect derived from the crime scene.
(C) Any tangible object that can establish that a crime has or has not been committed or can link a crime and its victim or its perpetrator.
(D) Testimonial statements recorded by the first responding police officer.

5. Which of the following is an example of identifying a class characteristic of an evidence item?
(A) Determining that a paint chip originated from a 2018 Maruti Swift car based on chemical composition.
(B) Matching microscopic striation marks on a fired bullet to a specific firearm seized from a suspect.
(C) Matching the torn edges of a recovered piece of paper to a specific notebook found in suspect's desk.
(D) Matching a latent fingerprint recovered from a glass window to the unique friction ridge pattern of a suspect.

6. The process of determining that two physical items share a common unique origin, to the exclusion of all other possible origins, is known as:
(A) Classification
(B) Identification
(C) Association
(D) Individualisation

NODIA

7. According to Locard's Exchange Principle, a core concept in trace evidence examination, which of the following statements is true?
(A) Trace evidence transfer occurs exclusively during violent personal crimes and cannot occur during property offenses.
(B) Every contact leaves a trace, resulting in a mutual exchange of physical material between contacting surfaces.
(C) Transfer of trace evidence occurs only when fluid biological materials are physically exchanged between subjects.
(D) Trace evidence inherently degrades and dissipates within 24 hours of transfer regardless of environmental factors.

8. Consider the following statements regarding the probative value of physical evidence:
I. Physical evidence generally has greater

locations and proves the victim was relocated after initial bloodshed, directly supporting spatial sequence and relational reconstruction determinations.

70. (C) III only
In suicidal hanging, ligature marks characteristically form an inverted V-shape pointing toward the knot. Manual strangulation frequently leaves fingertip and thumb abrasions or bruises on the neck. Hyoid bone fracture does not occur in 100% of asphyxial cases, as hyoid ossification varies with age, making the third statement scientifically incorrect.

71. (D) Ambient and rectal body temperatures
The Glaister equation is a classical formula used in forensic pathology to estimate the post-mortem interval based on body cooling rates. Calculating time since death using this formula requires measuring two core variables: the victim's internal rectal body temperature at discovery and the ambient temperature of the surrounding environment.

72. (A) The maximum free-fall speed reached when air resistance balances gravity
Terminal velocity is the maximum constant free-fall speed attained by a falling body or blood droplet through air. It occurs when downward gravitational force is perfectly balanced by the upward drag force of air resistance, preventing further acceleration and causing the droplet to fall at a uniform constant terminal velocity.

73. (B) Circular with smooth edges
When a falling blood droplet strikes a smooth, non-porous horizontal surface at a perpendicular ninety-degree angle, force radiates equally outward in all lateral directions. Surface tension breaks symmetrically around the impact center, producing a circular stain featuring smooth edges and an equal length-to-width ratio without directional tailing.

74. (B) Drip pattern
A drip pattern is formed when liquid blood drops fall vertically into an accumulated pool of standing blood or onto a liquid-covered target. The impact of falling drops into liquid displaces surface fluid, generating characteristic secondary splash spatter, peripheral satellite droplets, and irregular spines projecting around the central liquid pool.

75. (A) P-2, Q-3, R-4, S-1
Terminating glass fractures indicate shooting sequence because younger fractures terminate at older ones. Livor mortis located on a victim's back while lying face down proves post-mortem body movement. An overturned chair near a disturbance is relational evidence of a struggle, while smeared bloodstains on walls indicate motion and wiping action.

76. (C) Forcing the rod through tissue/material, altering original trajectory
When placing trajectory rods through bullet impact defects in soft materials or human tissue, investigators must carefully avoid forcing rods through resistant structural barriers. Forcing trajectory rods alters original defect geometry, creates artificial path tracks, and distorts spatial alignment, leading to erroneous angular calculations and flawed bullet path reconstructions.

77. (D) Trigonometric principles
Determining the three-dimensional area of origin in bloodstain pattern analysis relies fundamentally on trigonometric principles. By treating the linear distance from a stain to the two-dimensional area of convergence as the adjacent side of a right triangle, investigators apply tangent trigonometric calculations to determine spatial height above the convergence point.

78. (C) Absence of carboxyhemoglobin in the victim's blood
In fire investigations involving fatalities, analyzing blood carboxyhemoglobin levels establishes whether a victim was alive during the fire event. Individuals alive during ignition inhale carbon monoxide, forming carboxyhemoglobin. The absence of carboxyhemoglobin confirms respiratory activity stopped prior to fire exposure, proving death occurred before the fire started.

79. (B) Back spatter
Back spatter consists of blood droplets directed back toward the source of energy or weapon. In close-range or contact gunshot injuries, expanding propellant gases entering tissues create high pressure, driving blood and biological tissue backward into the firearm barrel interior, serving as physical evidence linking a weapon to a shooting.

Downloaded from www.pdf.tube

procedures under the law.
(B) A latent fingerprint identified on a metallic safe surface linking a specific suspect to the crime scene.
(C) Glass fracture patterns indicating the sequence and direction of bullet impacts.
(D) A full short tandem repeat (STR) DNA profile match obtained from a dried bloodstain recovered at the scene.

17. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Transient evidence must be recorded and documented immediately by the first responding officer at a crime scene.
Reason (R): Transient evidence consists of physical phenomena, such as smells or temperatures, that will rapidly degrade, dissipate, or disappear.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

18. Biological evidence such as bloodstained clothing recovered from a crime scene should generally be packaged in:
(A) Airtight non-porous plastic bags sealed tightly to prevent external contamination.
(B) Clean glass jars tightly sealed with melted paraffin wax around the lid.
(C) Heavy-duty metal containers or tins fitted with airtight rubberized lids.
(D) Breathable paper bags or envelopes to prevent mould growth.

19. When handling digital evidence, such as a suspect's computer hard drive, the use of a "write blocker" is essential to:
(A) Prevent any modification or alteration of the original drive data during forensic analysis.
(B) Significantly increase the speed and data transfer rate during the extraction of large digital files.
(C) Decrypt password-protected or encrypted user files automatically upon connection to the workstation.
(D) Filter and delete temporary or irrelevant system files prior to creating a forensic bit-stream image.

NODIA

20. The persistence of trace evidence on a surface after a transfer event depends on several factors. Which of the following is NOT typically considered a primary factor affecting persistence?
(A) The nature of the receiving surface (e.g., rough vs. smooth).
(B) The activity of the suspect or item after the transfer.
(C) The specific statutory law under which the crime is charged.
(D) The time elapsed since the transfer occurred.

21. When comparing testimonial evidence to physical evidence, forensic scientists generally consider physical evidence to be:
(A) More objective, as it is free from memory loss, bias, or intimidation.
(B) More subjective and highly prone to memory decay, emotional bias, and cognitive distortions over time.
(C) Less reliable than eyewitness statements because it depends entirely on subjective expert interpretation.
(D) Legally inferior to direct testimony provided by an eyewitness who personally observed the crime take place.

22. Consider the following statements regarding destructive and non-destructive testing of physical evidence:
I. Non-destructive techniques should always be applied before destructive techniques.
II. Microscopic examination is generally considered a non-destructive technique.
III. Gas Chromatography-Mass Spectrometry (GC-MS) is a non-destructive technique.
IV. If an evidence sample is very small, destructive testing requires careful sub-sampling and often permission from the court.
Which combination of statements is correct?
(A) I, II and III only
(B) I, II and IV only
(C) II, III and IV only
(D) I, III and IV only

23. The evidential significance of class characteristics in a criminal investigation is that they:
(A) Point directly to one specific individual or weapon to the absolute exclusion of all other potential sources in the population.
(B) Definitively exclude a suspect whose reference sample lacks matching class characteristics.
(C) Possess no meaningful probative value or

legal relevance during judicial proceedings in a court of law.
(D) Be restricted exclusively to civil litigation disputes while remaining entirely inadmissible in criminal prosecutions.

24. In the standard hierarchy of forensic examination, the initial step of determining the physical or chemical identity of a substance with absolute certainty is called:
(A) Individualisation
(B) Association
(C) Identification
(D) Reconstruction

25. Which of the following scenarios is a definitive example of primary transfer?
(A) A suspect sits on a chair, leaving a fibre, and later the victim sits on the same chair, picking up the fibre.
(B) A dog hair on a suspect's shoe is deposited onto the floormat of a police vehicle.
(C) An investigating officer accidentally drops a hair onto a crime scene exhibit.
(D) A victim's blood sprays directly onto the suspect's clothing during an assault.

26. Arrange the following types of evidence in the typical recommended order of collection at a crime scene based on their fragility (from most fragile to least fragile):
I. Microscopic trace evidence (e.g., loose fibres on a floor)
II. Transient evidence documentation (e.g., noting odours, temperature)
III. Heavy movable objects (e.g., a bloodstained chair)
IV. Standard/reference biological samples from victims
Which of the following is the correct order?
(A) II, I, III, IV
(B) I, II, IV, III
(C) II, III, I, IV
(D) III, II, I, IV

27. Demonstrative evidence is best defined as:
(A) The actual physical objects directly used or involved during the commission of a crime, such as a firearm or weapon.
(B) Items created to illustrate or clarify real evidence, such as scale models, diagrams, or 3D animations.
(C) Formal oral testimony delivered under oath before the court by a qualified forensic expert or technical investigator.
(D) Self-explanatory physical evidence that establishes a crime without requiring any corroborating witness testimony.

28. Under evidence law, physical evidence is considered relevant if it satisfies which of the following?
(A) The Doctrine of Res Judicata as codified under procedural civil and criminal law codes
(B) The provisions on Relevancy of Facts under statutory evidence law
(C) The Constitutional Principle of Double Jeopardy preventing multiple prosecutions
(D) The Rule against Hearsay Evidence applied strictly without statutory exceptions

29. Consider the following statements regarding the limitations of Locard's Exchange Principle:
I. While an exchange always occurs during contact, the transferred material may be too minimal to detect with current instrumentation.
II. Environmental factors like rain or wind can rapidly destroy trace evidence before it is collected.
III. The principle implies that highly skilled criminals can commit violent crimes without leaving any trace evidence whatsoever if they wear protective suits.
Which of the given statements is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

30. Which of the following is considered an example of chemical evidence?
(A) A latent friction ridge fingerprint recovered from a glass surface.
(B) A questioned handwritten signature appearing on a disputed legal document.
(C) Accelerant residues extracted from arson debris.
(D) Insect larvae or maggots collected from a decomposing biological body.

31. Conditional evidence produced by a specific event or action at a crime scene is best exemplified by:
(A) The specific ABO blood type and antigen composition determined from a victim's reference sample.
(B) The unique nuclear short tandem repeat

Click Here to Buy book on Amazon

(STR) DNA profile generated from suspect reference samples.
(C) The microscopic individual striation marks impressed onto the exterior surface of a fired cartridge case.
(D) The state of crime scene lighting (on/off) and windows (open/closed) upon officer arrival.

32. Reconstruction evidence helps an investigator understand the events that occurred during a crime. Which of the following techniques heavily relies on reconstruction evidence?
(A) Estimating blood alcohol concentration from a suspect's blood sample.
(B) Identifying the species origin of a bloodstain.
(C) Bloodstain pattern analysis to determine the position of the victim.
(D) Determining the exact chemical composition of a seized narcotic.

33. Why is it standard operating procedure in forensic science laboratories to perform non-destructive testing before destructive testing?
(A) Non-destructive screening techniques are inherently faster, less expensive, and require simple field apparatus.
(B) It preserves evidence in its original state, allowing independent re-examination by the court or defence.
(C) Destructive analytical methods are inherently less accurate and scientifically reliable than non-destructive ones.
(D) Destructive analytical testing is strictly prohibited by statutory procedural codes under all investigative scenarios.

34. To meaningfully compare physical evidence from a crime scene, a forensic scientist must also be provided with:
(A) The suspect's complete criminal history.
(B) The initial crime report filed by the complainant.
(C) Demonstrative models of the crime scene.
(D) Standard or reference samples of known origin.

35. Match the forensic databases in List I with the type of physical evidence they manage in List II.
List I: (Forensic Databases)
P. NAFIS
Q. IBIS
R. CODIS
S. SICAR
List II: (Types of Physical Evidence)
1. DNA profiles
2. Shoeprint and tire tread marks
3. Fingerprints and palm prints
4. Ballistic images (cartridge cases and bullets)
(A) P-3, Q-4, R-1, S-2
(B) P-1, Q-2, R-3, S-4
(C) P-3, Q-1, R-4, S-2
(D) P-4, Q-3, R-2, S-1

NODIA

36. Sub-sampling is a critical step when analyzing a large seizure of suspected narcotics (e.g., 100 packets of heroin). The primary objective of sub-sampling is to:
(A) Ensure that all 100 seized packets are entirely consumed and destroyed during initial screening to prevent potential theft.
(B) Safely dilute high-purity narcotic samples down to low toxicity levels suitable for routine handling by laboratory staff.
(C) Obtain a representative portion accurately reflecting the entire bulk seizure without testing every packet.
(D) Mechanically separate outer physical packaging and masking materials from the underlying chemical substance prior to storage.

37. Which of the following scenarios best demonstrates the probative value of combined class evidence?
(A) Finding a red fibre, a size 10 shoe mark, and type O blood, all independently matching the suspect.
(B) Finding a latent fingerprint on a door frame that uniquely and perfectly matches the friction ridge pattern of a suspect.
(C) Hearing an eyewitness state during testimony that they observed an unknown male running away from the scene at night.
(D) Recovering a fired bullet from the victim showing unique individual microscopic striations matching the suspect's handgun.

38. Which of the following is the correct sequence of examination when analyzing trace evidence like paint or fibres in a forensic laboratory?
(A) Destructive chemical analysis → Stereomicroscopic examination → Collection and documentation → Report writing
(B) Collection and documentation → Stereomicroscopic examination → Non-destructive instrumental analysis (e.g., FTIR) → Destructive analysis

criminal act.
III. Confession of the accused before a police officer.
Which of the above are fundamental elements that must be established to prove Corpus Delicti?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

74. Bloodstain pattern analysis can indicate the direction of travel, the angle of impact, and the point of origin of blood droplets. This specific analytical approach is primarily generating:
(A) Reconstruction evidence
(B) Circumstantial biological evidence
(C) Trace evidence
(D) Digital evidence

75. Which technique is most appropriate for the collection of microscopic trace evidence (like synthetic fibres) from a car seat without damaging the substrate?
(A) Vigorous mechanical scraping using a sharp metal scalpel blade
(B) Lifting with low-tack forensic tape
(C) Applying aggressive organic chemical solvents directly to the fabric
(D) Cutting and removing the entire car seat upholstery for laboratory extraction

76. Secondary transfer of trace evidence can complicate forensic investigations because:
(A) It conclusively proves that the suspect was physically present at the primary crime scene during the offense.
(B) It can create a false association, implying direct contact when transfer occurred via an intermediary object.
(C) It causes the immediate physical destruction and degradation of pre-existing primary transfer evidence items.
(D) It represents a theoretical concept that is explicitly excluded from Locard's Exchange Principle frameworks.

77. A forensic laboratory receives a bedsheet recovered from a sexual assault crime scene. Which class of evidence does a suspected semen stain on this bedsheet fall under?
(A) Biological evidence
(B) Transient evidence
(C) Impression evidence
(D) Demonstrative evidence

78. Which of the following categories of evidence encompasses seized illicit drugs submitted to a forensic laboratory for qualitative and quantitative analysis?
(A) Digital Evidence
(B) Pattern Evidence
(C) Chemical Evidence
(D) Testimonial Evidence

79. Match the examination techniques in List I with their classification as destructive or non-destructive in List II.
List I: (Examination Techniques)
P. Visual examination under varied lighting
Q. Acid digestion for heavy metal testing
R. Firing a suspect weapon to obtain test bullets
S. 3D laser scanning of a crime scene
List II: (Classification)
1. Destructive technique
2. Non-destructive technique
(A) P-2, Q-1, R-1, S-2
(B) P-1, Q-2, R-2, S-1
(C) P-2, Q-2, R-1, S-1
(D) P-1, Q-1, R-2, S-2

80. Physical evidence is highly valuable when it conclusively excludes a suspect. An exclusion occurs when:
(A) All measured class characteristics of recovered physical evidence match the suspect's known reference sample.
(B) The recovered evidence item is severely degraded yet exhibits partial morphological similarity to reference material.
(C) Evidence characteristics differ significantly and unexplainably from the reference sample.
(D) The unbroken chain of custody record for the evidence item remains completely documented, intact, and verified.

81. Arrange the following stages of evidential association in ascending order of their probative weight (from lowest individualizing power to highest):
I. Identification of chemical substance (e.g., determining a white powder is cocaine).
II. Physical match/Jigsaw fit (e.g., matching a torn piece of tape exactly to a roll).
III. Class characteristic comparison (e.g., determining a shoe print is a size 9 Nike).
Which of the following is the correct order?
(A) I, III, II

Downloaded from www.pdf.tube

of glass fitting into a window pane.

Which of the above are examples of CLASS characteristics?

(A) I and III only
(B) II and IV only
(C) I, II and III only
(D) I, III and IV only

48. In the context of evidence classification, a suicide note retrieved from a crime scene that requires handwriting analysis is primarily classified as:

(A) Real evidence
(B) Transient evidence
(C) Documentary evidence
(D) Trace evidence

49. Finding a wallet containing the suspect's identity card at the scene of a burglary is an example of:

(A) Transient evidence
(B) Associative evidence
(C) Exculpatory evidence
(D) Trace evidence

50. "Real evidence" in legal terms refers strictly to:

(A) Uncontested oral testimony delivered under oath in court by an investigating police officer.
(B) Theoretical crime scene reconstruction models presented in detailed expert witness reports.
(C) Any form of direct evidence that does not rely on inferences to establish a fact in issue.
(D) Physical, tangible objects involved in the crime brought to court for judicial inspection.

51. Consider the following statements regarding documentary evidence:

I. Primary evidence refers to the original document itself produced for the inspection of the court.
II. Secondary evidence refers to copies made from the original or oral accounts of the contents of a document.
III. Secondary evidence is always preferred over primary evidence in forensic document examination.

Which of the given statements is/are correct?

(A) I only
(B) I and II only
(C) II and III only
(D) I, II and III

52. Which of the following best represents pattern evidence?

(A) A single microscopic speck of lead or primer gunshot residue recovered from a hand.
(B) An unlabelled glass bottle containing an unknown toxic chemical or liquid poison.
(C) Blood spatter distribution cast off onto a wall.
(D) The recorded core internal body temperature measured from a deceased individual.

53. The evidential value of an identified transfer of fibres from a suspect's sweater to a victim's shirt is considered high because it suggests:

(A) Physical contact occurred between the garments or a shared environment.
(B) The suspect and victim maintained a personal relationship involving mutual animosity and enmity.
(C) The suspect operates as the sole commercial manufacturer of that specific brand and style of sweater.
(D) The offense occurred at a specific, verifiable time of day recorded by environmental evidence.

NODIA

54. For a forensic fingerprint expert to declare an "individualisation" (a positive match between a latent print and a suspect print), they must establish:

(A) That both fingerprint patterns share the same overall class characteristic pattern type, such as a whorl or loop.
(B) That the organic chemical composition of sweat recovered from the print matches the suspect's reference profile.
(C) The precise chronological time and environmental conditions under which the latent fingerprint was deposited.
(D) Matching minutiae sequence and spatial relationship with no unexplained differences.

55. In analytical forensic chemistry, a sample collected from a known, uncontaminated area near the crime scene (e.g., unstained carpet near a bloodstain) to ensure the background material does not interfere with the testing is called a:

(A) Reference sample
(B) Control/Substrate sample
(C) Transient sample
(D) Primary evidence sample

56. Which of the following represents a critical evidence handling error that could lead to the degradation and inadmissibility of the evidence?

(A) Storing a seized mobile device inside a

(C) Report writing → Stereomicroscopic examination → Destructive analysis → Non-destructive analysis
(D) Non-destructive instrumental analysis → Collection and documentation → Stereomicroscopic examination → Destructive analysis

39. An expert opinion on physical evidence provided by a forensic scientist is generally admissible in court under which legal provision?
(A) Section 300 of penal law governing murder offences
(B) Section 45 of evidence law governing expert opinion
(C) Section 161 of procedural law on witness statements
(D) Section 144 of procedural law on urgent orders

40. Contamination of physical evidence is a major handling error. Which of the following best describes contamination?
(A) The progressive biological degradation and putrefaction of organic evidence samples over extended time periods.
(B) The intentional destruction, concealment, or tampering of physical crime scene evidence performed by a suspect.
(C) Unintentional introduction of extraneous material to evidence post-crime by personnel.
(D) The standardized procedural method used for safely packaging and hermetically sealing an evidence container.

41. The unbroken, documented record of the transfer, possession, handling, and storage of physical evidence from the moment of collection to its final disposition is known as:
(A) Corpus Delicti
(B) Locard's Exchange Record
(C) Relevancy Roster
(D) Chain of Custody

42. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Microscopic examination is typically the first analytical step performed on recovered trace evidence.
Reason (R): Microscopic techniques are non-destructive and allow the examiner to observe morphological class characteristics before subjecting the sample to chemical testing.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

43. Evidence that tends to establish the guilt of the accused is formally known as:
(A) Exculpatory evidence
(B) Inculpatory evidence
(C) Conditional evidence
(D) Demonstrative evidence

44. A forensic expert receives a shirt belonging to a suspect in a stabbing case. Finding microscopic, invisible traces of the victim's blood on the cuff is an example of identifying:
(A) Transient evidence
(B) Trace evidence
(C) Impression evidence
(D) Documentary evidence

45. During a hit-and-run investigation, paint chips from the suspect's vehicle are found embedded in the victim's clothing. Which principle is primarily relied upon to justify the collection and analysis of these paint chips?
(A) Locard's Exchange Principle
(B) Principle of Double Jeopardy
(C) Principle of Corpus Delicti
(D) Principle of Exculpation

46. A major limitation of physical evidence is that it often cannot:
(A) Accurately determine the elemental or molecular chemical composition of an unknown bulk substance.
(B) Provide definitive genetic individualization when analyzing pristine nuclear DNA samples.
(C) Determine the precise time when evidence transfer occurred without contextual clues.
(D) Be effectively utilized by prosecution teams to corroborate eyewitness oral testimony.

47. Consider the following types of evidence:
I. The rifling pattern (number of lands and grooves) on a fired bullet.
II. The specific DNA profile obtained from a semen stain.
III. The tread design model of a Nike sports shoe.
IV. The unique fracture match of a broken piece

Click Here to Buy book on Flipkart

(C) Product Rule
(D) Doctrine of Probative Value

65. The position of a gearshift lever in a suspect vehicle involved in a fatal crash (e.g., in "Drive" or "Neutral") is documented by investigators. This is an example of:
(A) Biological evidence
(B) Conditional evidence
(C) Transient evidence
(D) Trace evidence

66. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Physical evidence is widely considered more reliable than testimonial evidence.
Reason (R): Physical evidence is objective; it does not have bias, cannot suffer from memory loss, and cannot deliberately perjure itself.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

67. Which of the following instrumental techniques is generally considered destructive to the chemical evidence sample?
(A) Gas Chromatography (GC)
(B) Stereomicroscopy
(C) Photography under alternate light sources
(D) Visual examination

68. Which of the following is an example of a non-destructive spectroscopic technique frequently used in examining trace evidence like paint or fibres?
(A) Liquid-Liquid Extraction
(B) Acid Digestion
(C) Fourier Transform Infrared Spectroscopy (FTIR)
(D) Thin Layer Chromatography (TLC) using chemical spraying

69. In forensic analysis of bulk chemical evidence, the term "representative sample" means that:
(A) The sample accurately reflects the composition of the bulk lot.
(B) The selected test portion represents the most heavily contaminated area of the evidence.
(C) The specimen was chosen specifically because it is visually distinct from surrounding items.
(D) Only certified reference calibration materials sourced directly from an accredited supplier are analyzed.

70. When a forensic expert prepares a technical report on evidence examination for court, the report must primarily be:
(A) Formulated to align directly with the investigating officer's working theory to ensure narrative consistency.
(B) Authored using highly complex technical jargon to prevent defense counsel from challenging scientific validity.
(C) Structured to provide a definitive conclusive judgment regarding the legal guilt or innocence of the accused.
(D) Objective, detailing methodology, scientific findings, and their limits.

71. In evidence law, what distinguishes "oral evidence" from "documentary evidence"?
(A) Oral evidence encompasses physical real evidence, whereas documentary evidence is strictly limited to electronic file records.
(B) Oral evidence is witness testimony, whereas documentary evidence comprises documents produced for judicial inspection.
(C) Oral testimony is classified as inherently primary proof, whereas documentary evidence is categorized as secondary proof.
(D) Oral testimony provided by witnesses is legally inadmissible during formal court proceedings in capital murder cases.

72. Which of the following statements about direct evidence is accurate?
(A) It relies entirely upon sophisticated laboratory analysis and advanced forensic techniques.
(B) It encompasses molecular DNA profile matches and friction ridge fingerprint individualization.
(C) It proves a fact directly without inference, such as an eyewitness seeing a crime.
(D) It is legally defined as being completely synonymous with tangible real or physical evidence.

73. Consider the following components regarding the concept of 'Corpus Delicti' in a murder investigation:
I. Proof that a death has occurred.
II. Proof that the death was caused by a

Downloaded from www.pdf.tube

shielded Faraday bag to block remote signals.
(B) Allowing a biological blood swab to air-dry completely prior to paper packaging.
(C) Sealing wet biological evidence in plastic in a warm area.
(D) Utilizing sterile disposable forceps to carefully recover loose hair evidence items.

57. An investigator searches a suspect's vehicle after a reported hit-and-run involving a pedestrian. The vehicle shows no damage, no removed paint, and no traces of blood or fabric from the victim. The absence of these findings is an example of:
(A) Irrelevant evidence
(B) Inadmissible evidence
(C) Primary evidence
(D) Negative evidence

58. Match the forensic concepts in List I with their appropriate descriptions in List II.
List I: (Forensic Concepts)
P. Identification
Q. Comparison
R. Individualisation
S. Reconstruction
List II: (Descriptions)
1. Determining if two items have a common origin.
2. Understanding the sequence of past events from physical evidence.
3. Determining a substance's physical or chemical identity.
4. Concluding an item came from a single, unique source.
(A) P-3, Q-1, R-4, S-2
(B) P-1, Q-3, R-2, S-4
(C) P-4, Q-2, R-3, S-1
(D) P-3, Q-4, R-1, S-2

59. The persistence of transferred fibres on a piece of clothing is heavily dependent on which of the following?
(A) The commercial brand label and retail pricing of the garment worn by the victim.
(B) Physical movement and activity level post-transfer, causing fibre shedding.
(C) The full nuclear DNA profile generated from epidermal cells attached to the garment.
(D) Whether the physical transfer event took place during daytime hours or at night.

60. While a single piece of circumstantial physical evidence may not definitively prove guilt, a strong case is built when:
(A) The accumulated circumstantial evidence points with equal probability to multiple independent suspects.
(B) Multiple independent pieces logically point to the same conclusion, excluding alternative hypotheses.
(C) It is formally converted into direct eye-witness evidence through judicial notice by the trial judge.
(D) The recovered evidence consists exclusively of common class characteristics shared across the general public.

NODIA

61. The primary duty of the first responder at a crime scene regarding physical evidence is to:
(A) Secure and protect the scene from contamination or loss.
(B) Immediately collect all visible physical items and dispatch them directly to the laboratory.
(C) Interrogate any available suspects thoroughly at the location prior to cordoning the area.
(D) Reconstruct the complete factual timeline of the crime for immediate public press briefings.

62. Which of the following is the correct hierarchical sequence of examination for physical evidence aiming to link it to a suspect?
(A) Individualisation → Identification → Comparison
(B) Comparison → Individualisation → Identification
(C) Identification → Comparison → Individualisation
(D) Identification → Individualisation → Comparison

63. The scent of a specific cologne lingering in a room where an assault just took place is a classic example of:
(A) Direct evidence
(B) Corpus delicti evidence
(C) Reconstructive evidence
(D) Transient evidence

64. When analyzing class characteristics, forensic scientists sometimes use statistical probabilities to determine the frequency of occurrence of a specific combination of traits in the general population. The mathematical principle commonly used for this, assuming the traits are independent, is the:
(A) Locard's Exchange Principle
(B) Principle of Superposition

(B) III, I, II
(C) I, II, III
(D) II, III, I

82. In the realm of digital evidence, data stored in a computer's Random Access Memory (RAM) is considered highly volatile. This makes it a modern equivalent to which traditional category of physical evidence?
(A) Trace evidence
(B) Impression evidence
(C) Documentary evidence
(D) Transient evidence

83. When prosecuting a case of forgery, submitting the original forged cheque to the court rather than a photocopy satisfies the evidentiary preference for:
(A) Primary documentary evidence
(B) Circumstantial evidence
(C) Secondary documentary evidence
(D) Corroborative testimony

84. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): DNA profiling from biological evidence can provide individualisation of a suspect.
Reason (R): Excluding identical twins, the specific sequence of DNA is unique to every single individual.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

85. During a presumptive chemical test for blood, a forensic scientist simultaneously runs the same test on a sample known not to contain blood. This is done to ensure the reagents are not producing a false positive. This known sample is termed a:
(A) Negative control
(B) Positive control
(C) Reference standard
(D) Substrate blank

86. Which of the following represents a significant limitation when analyzing microscopic fibre evidence transferred during a struggle?
(A) Microscopic fibres can never provide observable class characteristics such as dye shade or polymer composition.
(B) Recovered fibre evidence cannot be analyzed or documented using non-destructive optical microscopy techniques.
(C) The physical transfer of microscopic textile fibres directly violates the fundamental tenets of Locard's Exchange Principle.
(D) The exact time of fibre transfer cannot be determined from the fibre alone.

87. An investigator collects a fired cartridge case but places it in their unsealed pocket before returning to the station two hours later to place it in an evidence bag. Which core principle of evidence handling has been severely compromised?
(A) The Corpus Delicti
(B) The Chain of Custody
(C) The Product Rule
(D) The principle of primary transfer

88. Consider the following criteria generally required for physical evidence to be admissible in a court of law:
I. The evidence must be relevant to the facts in issue.
II. The evidence must have been collected legally without violating constitutional rights.
III. The chain of custody must be documented and demonstrably unbroken.
IV. The forensic techniques used to analyze the evidence must be generally accepted by the relevant scientific community.
Which combination of statements accurately reflects these requirements?
(A) I and III only
(B) II, III and IV only
(C) I, II and IV only
(D) I, II, III and IV

89. Corroborative evidence in a forensic context is best described as:
(A) Evidence introduced specifically to contradict or impeach testimony given by a key prosecution witness.
(B) A direct, uncorroborated judicial confession made voluntarily by an accused person during trial proceedings.
(C) Evidence that has been demonstrably tampered with, altered, or contaminated during law enforcement handling.
(D) Evidence from an independent source that supports or confirms other evidence.

Click Here to Buy book on Amazon

90. When writing a forensic examination report, if the physical evidence shares all class characteristics with a reference sample but lacks sufficient unique individual characteristics (e.g., a footprint with matching tread and size but no unique cuts or wear), the expert should conclude:

(A) An association where the suspect cannot be excluded, though others sharing those class traits are also included.

(B) Absolute individualisation, proving conclusively to the exclusion of all others that the suspect produced the mark.

(C) Absolute exclusion, establishing conclusively that the suspect or their property could not have produced the mark.

(D) That the physical evidence possesses no scientific or probative value and should be completely disregarded by the court.

www.nodia.in

NODIA

ANSWERS

1. (B) Information, physical items, or testimony legally submitted to a competent tribunal as a means of ascertaining the truth of any alleged matter of fact.
Evidence in forensic science and legal contexts encompasses any information, tangible items, or sworn testimony formally presented before a court or competent judicial tribunal. Its fundamental purpose is to establish or ascertain the truth regarding disputed facts in a legal proceeding. This comprehensive definition includes physical material, official documentation, and witness statements submitted under legal standards.

2. (D) Direct evidence
Direct evidence immediately proves a fact in issue without requiring any inference or presumption. An eyewitness account involves a first-person observation where the individual directly perceives the event taking place through their senses. Because the testimony directly asserts the truth of the fact being established, it is categorized as direct evidence rather than indirect forms.

3. (A) Direct evidence establishes a fact directly without needing an inference, while circumstantial evidence requires an inference to connect it to a conclusion of fact.
Direct evidence supports a factual proposition directly without requiring logical deduction, such as eyewitness testimony observing a crime. Conversely, circumstantial evidence relies on proof of a chain of facts or circumstances from which a tribunal must draw reasonable inferences to deduce a secondary fact in issue. Both forms are admissible and legally valid in proceedings.

4. (C) Any tangible object that can establish that a crime has or has not been committed or can link a crime and its victim or its perpetrator.
Physical evidence comprises any tangible item, substance, or material recovered during an investigation that serves to demonstrate whether an offense occurred. It assists investigators in establishing spatial, physical, or temporal connections between a crime scene, the victim, and the perpetrator. This broad category spans non-biological objects, biological samples, trace materials, and structural pattern marks.

5. (A) Determining that a paint chip originated from a 2018 Maruti Swift car based on chemical composition.
Class characteristics are physical or chemical properties shared by a group of objects rather than a single unique source. Determining that a paint chip matches the specific chemical formulation, vehicle line, and model year of a particular automobile brand narrows the evidence to a restricted class of mass-manufactured items without identifying one single specific car.

6. (D) Individualisation
Individualisation is the forensic process of demonstrating that a questioned item shares a common, unique origin with a known reference sample to the complete exclusion of all other potential sources. While identification assigns an item to a specific category or substance, individualisation establishes a unique origin based on unique individual traits like fingerprints.

7. (B) Every contact leaves a trace, resulting in a mutual exchange of physical material between contacting surfaces.
Locard's Exchange Principle asserts that whenever two objects or individuals come into physical contact with one another, a cross-transfer of physical material occurs. This fundamental concept forms the theoretical basis of forensic trace evidence analysis, establishing that perpetrators both leave physical traces at crime scenes and carry away physical materials from the environment.

8. (A) I and II only
Physical evidence provides objective data detached from human bias or faulty memory, giving it higher probative value than witness testimony. Combining multiple independent class characteristics significantly increases probative weight through statistical probability. However, physical evidence is not self-sufficient for conviction; it requires proper context, legal chain of custody documentation, and scientific interpretation.

Downloaded from www.pdf.tube

9. (D) Exculpatory evidence
Exculpatory evidence consists of physical items, biological data, documents, or witness statements that tend to establish the innocence of an accused person or relieve them of legal fault. Legal systems require prosecutors to disclose exculpatory evidence to the defense, ensuring fair trial proceedings. In contrast, inculpatory evidence implicates a suspect in criminal conduct.

10. (B) Secondary transfer
Primary transfer occurs when physical material moves directly from a primary source to a target surface during contact. Secondary transfer happens when transferred material is subsequently picked up by an intermediate object or person and deposited onto a third surface. In trace evidence analysis, secondary transfer explains how material appears on items without direct contact.

11. (B) Evidence that is temporary and easily lost or changed, such as crime scene odours, smoke, or ambient temperatures.
Transient evidence consists of physical observations that are temporary in nature and highly susceptible to alteration, dissipation, or rapid degradation over time. Common examples include ambient temperatures, volatile chemical odors, smoke, and transient physical marks. First responders must promptly observe and document transient evidence during initial crime scene response before environmental factors eliminate it.

12. (A) P-3, Q-4, R-1, S-2
Transient evidence includes short-lived physical phenomena like the smell of burnt explosives. Conditional evidence describes exact environmental conditions present during officer arrival, such as a radio playing loudly. Pattern evidence involves visible geometric configurations like blood spatter distribution. Trace evidence encompasses microscopic physical fragments, including synthetic fibers transferred during physical contact or movement.

13. (A) Link a suspect to a crime scene or a victim.
Associative evidence encompasses physical items or trace materials that establish a tangible connection between a suspect, victim, crime scene, or instrument of a crime. Examples include personal belongings, fingerprints, hair, and footwear impressions. By linking individuals to specific physical locations or objects, associative evidence assists forensic investigators in placing suspects at the scene.

14. (C) The absence of expected physical evidence, which can be just as significant as its presence in proving or disproving a fact.
Negative evidence refers to the documented absence of expected physical or biological materials at a crime scene where physical contact or specific actions allegedly occurred. In forensic science, the absence of expected evidence, such as missing bloodstains or unrecovered fingerprints, carries significant probative weight for testing witness statements, evaluating alibis, and verifying hypotheses.

15. (D) Evidence demonstrating that a crime has actually occurred, such as a broken window in a burglary.
Corpus delicti, meaning the body of the crime, refers to physical or factual evidence proving that a specific criminal act has taken place. Before establishing suspect liability, the prosecution must prove that actual harm or damage occurred through criminal agency rather than natural causes or accidents, such as forced entry marks.

16. (C) Glass fracture patterns indicating the sequence and direction of bullet impacts.
Reconstructive evidence provides physical data allowing forensic scientists to determine the sequence, direction, and nature of events that transpired during a crime. Radial and concentric glass fracture patterns reveal the direction of force and relative timing of impacts. This physical evidence supports spatial and chronological crime scene reconstruction without subjective descriptions.

17. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Transient evidence consists of fleeting environmental conditions, such as odors, surface temperatures, smoke, and volatile fumes, that dissipate quickly. Because these physical phenomena alter or disappear rapidly upon exposure to surrounding conditions, first responding officers must observe, record, and document them immediately upon arrival. Thus, the physical instability directly justifies prompt recordation.

NODIA

18. (D) Breathable paper bags or envelopes to prevent mould growth.
Biological evidence such as bloodstained clothing contains moisture that promotes bacterial growth and fungal decay when trapped in sealed container environments. Packaging moist biological evidence in breathable paper bags allows gradual air drying and ventilation. This packaging technique prevents microbial degradation of cellular structures and preserved genetic material, maintaining sample integrity for subsequent DNA testing.

19. (A) Prevent any modification or alteration of the original drive data during forensic analysis.
Digital forensics relies on strict procedures to ensure data integrity during acquisition and analysis. A hardware or software write blocker intercepts write commands sent to digital storage devices while allowing read access. This device prevents operating systems or analytical software from altering, modifying, or overwriting metadata and original file content during imaging.

20. (C) The specific statutory law under which the crime is charged.
The persistence of physical trace evidence on a surface is governed by physical, environmental, and temporal parameters. Factors such as surface texture, physical post-transfer activities, weather exposure, and time elapsed directly affect retention or loss. Legal definitions, procedural charges, or statutory provisions under criminal law have no physical bearing on trace evidence persistence.

21. (A) More objective, as it is free from memory loss, bias, or intimidation.
Physical evidence provides objective scientific data derived from physical objects, materials, or biological marks recovered from crime scenes. Unlike testimonial evidence, which is susceptible to cognitive distortions, memory decay, personal bias, misidentification, or intimidation, physical evidence remains uninfluenced by psychological factors. Its scientific interpretation depends entirely on verifiable laboratory analysis and documentation.

22. (B) I, II and IV only
Forensic analytical protocols prioritize non-destructive methods like microscopic observation to preserve original sample structure before applying destructive techniques. Chromatographic separation techniques such as Gas Chromatography-Mass Spectrometry consume and destroy tested sample portions. When evidence volume is limited, destructive testing requires sub-sampling procedures and judicial authorization to safeguard defense re-examination rights.

23. (B) Definitively exclude a suspect whose reference sample lacks matching class characteristics.
Class characteristics place physical evidence into broad categories shared by multiple items. While class characteristics cannot single out an individual source to the exclusion of all others, a clear discrepancy between questioned evidence and a reference sample definitively excludes that source. Exclusionary power is a fundamental application of class characteristic analysis.

24. (C) Identification
Identification in forensic science refers to establishing the precise physical or chemical identity of a substance with high scientific certainty using standardized analytical tests. This fundamental process determines what an unknown substance is, such as verifying illicit drugs, blood, or accelerants, prior to comparing the evidence item against known reference standards for source attribution.

25. (D) A victim's blood sprays directly onto the suspect's clothing during an assault.
Primary transfer occurs when physical material moves directly from its original source to a receiving surface through direct contact or physical projection during an event. High-velocity blood spatter moving directly from an injured victim onto an assailant's garment represents a direct physical transfer without any intermediary object, fitting primary transfer criteria.

26. (A) II, I, III, IV
Crime scene collection protocols prioritize items based on potential loss or environmental degradation. First, transient conditions such as ambient temperatures or odors must be documented immediately. Microscopic trace evidence is collected next before scene movement causes loss. Heavy physical objects are handled afterwards, followed by collecting standard reference biological samples under controlled laboratory conditions.

Click Here to Buy book on Flipkart

27. (B) Items created to illustrate or clarify real evidence, such as scale models, diagrams, or 3D animations.
Demonstrative evidence consists of visual aids, scale models, diagrams, charts, digital reconstructions, or 3D animations created specifically to assist triers of fact in understanding complex testimony or real evidence. Demonstrative items do not originate directly from the crime scene; rather, they visually represent spatial relationships, mechanisms, or factual physical evidence during court proceedings.

28. (B) the provisions on Relevancy of Facts under statutory evidence law
Under statutory evidence law, physical evidence is admissible in judicial proceedings if it satisfies statutory provisions governing the relevancy of facts. Evidence is legally relevant when it logically connects to a fact in issue or a relevant fact, helping to prove or disprove factual allegations made by counsel within a structured trial framework.

29. (A) I and II only
While Locard's Exchange Principle dictates that physical material transfers during surface contact, instrumental detection limits can hinder identifying extremely minute microscopic transfers. Furthermore, environmental elements like rain, wind, or heat can disperse or destroy trace evidence post-transfer. However, wearing protective clothing does not eliminate physical contact transfers entirely during criminal activities.

30. (C) Accelerant residues extracted from arson debris.
Chemical evidence comprises substances identified through chemical analysis of their composition, molecular structure, or elemental properties. Accelerant residues extracted from fire debris, such as gasoline, kerosene, or diesel fuel, are categorized as chemical evidence. In contrast, friction ridge prints represent impression evidence, and insect larvae represent biological forensic evidence items.

31. (D) The state of crime scene lighting (on/off) and windows (open/closed) upon officer arrival.
Conditional evidence refers to physical information produced by a specific action, event, or environmental setting at a crime scene. Physical observations such as whether lights are switched on or off, doors or windows are open or closed, and locks are engaged reflect scene conditions upon initial officer arrival, aiding in establishing event timelines.

32. (C) Bloodstain pattern analysis to determine the position of the victim.
Reconstruction evidence consists of physical patterns and spatial distributions that assist forensic examiners in re-creating the sequence, locations, and actions during a crime. Bloodstain pattern analysis uses spatial geometry, droplet shape, and distribution to determine impact angles, point of origin, and relative physical positions of individuals during violent criminal events.

33. (B) It preserves evidence in its original state, allowing independent re-examination by the court or defence.
Executing non-destructive physical or optical testing prior to destructive chemical analysis ensures that evidence remains preserved in its original form for as long as possible. Non-destructive methods document essential physical characteristics, enabling independent scientific verification, defense expert re-examination, or re-testing ordered by judicial authorities without irreversibly consuming finite physical evidence samples.

NODIA

34. (D) Standard or reference samples of known origin.
Comparative forensic analysis requires comparing questioned evidence recovered from a crime scene against standard or reference samples of verified, known origin. Reference samples, such as known blood samples, exemplar handwriting, or suspect firearms, provide baseline characteristics needed to establish physical matches, shared class traits, or definitive exclusions during scientific laboratory examinations.

35. (A) P-3, Q-4, R-1, S-2
National Automated Fingerprint Identification System (NAFIS) manages fingerprint and palm print database records. Integrated Ballistics Identification System (IBIS) processes microscopic firearm and bullet markings. Combined DNA Index System (CODIS) stores forensic and offender biological DNA profiles. Shoe Image Capture and Retrieval (SICAR) manages comparative database imagery of

footwear impressions and automobile tire tread patterns.

36. (C) Obtain a representative portion accurately reflecting the entire bulk seizure without testing every packet.
When analyzing large physical seizures containing numerous individual packages of suspected controlled substances, forensic chemists employ standardized statistical sub-sampling protocols. Sub-sampling yields a representative, manageable sample portion whose chemical composition accurately reflects the entire bulk consignment, optimizing laboratory analytical efficiency while maintaining legal scientific validity during formal court trial proceedings.

37. (A) Finding a red fibre, a size 10 shoe mark, and type O blood, all independently matching the suspect.
Individual class characteristics have broad population frequencies, but combining multiple independent class characteristics drastically decreases the mathematical probability of a random coincidence occurring. Finding multiple distinct class evidence items—such as matching textile fibers, specific footwear size marks, and identical blood group types—substantially strengthens associative proof linking a suspect to a scene.

38. (B) Collection and documentation → Stereomicroscopic examination → Non-destructive instrumental analysis (e.g., FTIR) → Destructive analysis
Forensic examination of trace evidence follows a strict sequence prioritizing sample preservation. Evidence is first thoroughly documented and collected at the scene. Initial laboratory analysis utilizes non-destructive stereomicroscopy to evaluate morphological features, followed by non-destructive instrumental techniques like FTIR spectroscopy. Destructive chemical testing is performed last only if required for comprehensive identification.

39. (B) Section 45 of evidence law governing expert opinion
Under evidence law, expert opinion regarding physical, biological, or chemical evidence is admissible under statutory provisions governing expert testimony, such as Section 45. Courts admit expert findings when scientific, technical, or specialized knowledge beyond common understanding is required to interpret physical evidence, evaluate laboratory data, and assist judicial decision-making during trials.

NODIA

40. (C) Unintentional introduction of extraneous material to evidence post-crime by personnel.
Contamination refers to the inadvertent, post-crime introduction of foreign physical, chemical, or biological materials into evidence by scene responders, investigators, or laboratory analysts. Contamination compromises evidence integrity, produces false analytical results, and complicates interpretation, underscoring the necessity of protective equipment, sterile packaging, and proper handling protocols during forensic crime investigations.

41. (D) Chain of Custody
The chain of custody is a chronological, unbroken written log documenting the collection, custody, transfer, analysis, and disposition of physical evidence. Maintaining a complete chain of custody establishes legal integrity and proves that evidence submitted to court remains in the same condition as when collected, preventing tampering, substitution, or unrecorded handling.

42. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Microscopic examination serves as the initial step in analyzing recovered trace evidence because it is non-destructive and preserves sample integrity. Optical microscopy allows analysts to document visual, structural, and morphological class features of trace materials without altering them, providing essential observational data before subjecting samples to destructive chemical or instrumental techniques.

43. (B) Inculpatory evidence
Inculpatory evidence consists of physical items, biological samples, documents, or witness statements that tend to establish the guilt of an accused individual or link them directly to a crime. In legal proceedings, prosecution teams present inculpatory evidence to satisfy the burden of proof, contrasting with exculpatory evidence which indicates innocence or mitigates legal fault.

44. (B) Trace evidence
Trace evidence refers to minute, often microscopic physical or biological materials transferred during contact between individuals,

objects, or crime scenes. Microscopic, non-visible bloodstains detected on clothing cuffs represent trace evidence. Analyzing trace evidence requires specialized detection tools and laboratory techniques to recover, identify, and associate transferred materials with potential known sources.

45. (A) Locard's Exchange Principle
Locard's Exchange Principle holds that physical contact between two objects leads to an exchange of physical material. In hit-and-run incidents, physical contact between a vehicle and a pedestrian's clothing leads to paint transfer. Collecting and analyzing paint chips relies on this foundational principle to establish physical association between vehicle and victim.

46. (C) Determine the precise time when evidence transfer occurred without contextual clues.
Physical evidence provides objective data regarding identity, origin, and association, but physical material alone cannot inherently disclose the precise chronological time or date when transfer occurred. Establishing the exact timing of transfer relies on external contextual clues, situational evidence, witness testimony, or environmental indicators surrounding the primary crime scene location.

47. (A) I and III only
Class characteristics are properties shared by an entire group or mass-produced class of items, such as the general rifling design of firearm barrels or mass-manufactured shoe tread designs. In contrast, nuclear DNA profiles and physical jigsaw fracture matches represent individual characteristics capable of attributing evidence to a single, unique source.

48. (C) Documentary evidence
Documentary evidence encompasses any written, printed, or recorded instrument presented to prove a fact through its contents or physical attributes. A suicide note retrieved at a crime scene represents documentary evidence because its written text, handwriting characteristics, ink, and paper substrate are subjected to document examination to assess authorship and authenticity.

49. (B) Associative evidence
Associative evidence consists of physical items or personal effects that place an individual at a specific location or link them to a victim or crime scene. Finding a wallet containing a suspect's identification card at a crime scene directly connects that specific individual to the physical location, serving as associative evidence.

50. (D) Physical, tangible objects involved in the crime brought to court for judicial inspection.
Real evidence, also referred to as physical or material evidence, consists of tangible, physical objects directly involved in or originating from the commission of an offense. Examples include weapons, narcotics, clothing, and recovered stolen property. Real evidence is physically presented in court for judicial inspection, requiring proper authentication and custody verification.

51. (B) I and II only
Primary documentary evidence refers to the original document itself produced for judicial inspection, whereas secondary evidence includes copies or oral testimony describing document contents. Under evidence rules, primary evidence is legally preferred. Secondary evidence is admissible only under specific statutory exceptions where the original document is shown to be lost, destroyed, or legally unavailable.

52. (C) Blood spatter distribution cast off onto a wall.
Pattern evidence consists of physical configurations, geometric distributions, or spatial arrangements produced by physical contact or dynamic forces. Blood spatter distribution cast off onto a wall represents pattern evidence because its geometric shapes, drop sizes, and spatial distribution allow analysts to reconstruct dynamics, impact energy, directionality, and relative positions during a crime.

53. (A) Physical contact occurred between the garments or a shared environment.
Finding transferred textile fibers from a suspect's sweater on a victim's shirt provides scientific evidence of physical contact or shared proximity between the garments. Because fibers transfer readily during personal contact or friction between surfaces according to Locard's Exchange Principle, matching fiber types, dyes, and polymer structures supports direct physical interaction.

Downloaded from www.pdf.tube

54. (D) Matching minutiae sequence and spatial relationship with no unexplained differences.
Forensic fingerprint individualisation requires establishing that a latent friction ridge print matches a known reference print in ridge characteristics, minutiae types, relative spatial relationships, and continuous sequence. An expert can declare individualisation only when sufficient matching minutiae details are present and no genuine, unexplained structural differences exist between the questioned and reference friction ridge prints.

55. (B) Control/Substrate sample
A control or substrate sample is unstained background material collected from an area adjacent to where evidence was recovered. Analyzing substrate control samples enables forensic scientists to verify that matrix components, background chemicals, or surface materials do not produce false positives or interfere with analytical testing performed on recovered physical evidence samples.

56. (C) Sealing wet biological evidence in plastic in a warm area.
Sealing wet biological evidence, such as blood or semen stains, inside non-porous plastic containers in warm conditions traps moisture and accelerates bacterial and fungal growth. Microbial proliferation rapidly degrades DNA cellular structures and organic components, destroying evidence value and rendering it scientifically unsuitable for laboratory testing and court in formal court trial proceedings.

57. (D) Negative evidence
Negative evidence refers to the documented absence of expected physical materials, transfer marks, or biological stains at a crime scene or on a suspect item. In a hit-and-run investigation, the complete absence of impact damage, paint transfer, or victim biological material on a suspect vehicle provides probative negative evidence evaluating claims.

58. (A) P-3, Q-1, R-4, S-2
Identification determines the specific physical or chemical identity of an unknown substance. Comparison evaluates questioned items against known reference samples to determine if they share common origins. Individualisation establishes that an item originated from a single, unique source to the exclusion of all others. Reconstruction uses physical evidence to deduce past crime events.

59. (B) Physical movement and activity level post-transfer, causing fibre shedding.
Fibre persistence on textile surfaces is dynamic, with transferred loose fibers shedding rapidly over time following a physical transfer event. Physical activity, bodily movement, surface friction, and contact with other materials significantly accelerate fiber shedding. Higher activity levels post-transfer reduce the concentration of persistent fibers remaining attached to a garment substrate.

60. (B) Multiple independent pieces logically point to the same conclusion, excluding alternative hypotheses.
Circumstantial evidence derives strength from the convergence of multiple independent facts pointing toward a single logical conclusion. While individual pieces of circumstantial physical evidence may only possess class traits, a cohesive network of independent circumstantial items mutually corroborates a single hypothesis while systematically excluding reasonable alternative explanations or alternative coincidences.

NODIA

61. (A) Secure and protect the scene from contamination or loss.
The paramount objective of first responding officers at a crime scene is securing and cordoning the area to prevent physical evidence contamination, alteration, or destruction. Establishing boundary perimeters, restricting unauthorized personnel access, and preserving environmental conditions safeguard the physical scene integrity required for effective technical search, documentation, and evidence collection protocols.

62. (C) Identification → Comparison → Individualisation
Forensic examination follows a logical hierarchy when evaluating physical evidence. The examiner first performs identification to verify the physical or chemical nature of the unknown substance. Next, comparative analysis evaluates the evidence alongside known reference standards to assess shared class characteristics. Finally, if unique individualizing features are detected, individualisation is concluded.

63. (D) Transient evidence
Transient evidence refers to ephemeral, unstable physical observations that rapidly dissipate or change over time. Volatile chemical vapors, such as cologne scents, perfume odors, or smoke, diminish quickly through atmospheric dispersion and airflow. Because these olfactory indicators dissipate rapidly post-crime, they are classified as transient evidence requiring immediate crime scene documentation.

64. (C) Product Rule
The Product Rule is a mathematical formula used in forensic statistics to determine the combined frequency of occurrence of multiple independent class characteristics within a given population. By multiplying the individual probabilities of independent traits together, forensic scientists calculate overall frequency, demonstrating how combining common class characteristics significantly narrows potential suspect source pools.

65. (B) Conditional evidence
Conditional evidence reflects physical information generated by specific actions or environmental states present at a crime scene. Physical settings such as vehicle gearshift positions, light switch states, door lock engagements, and window positions provide conditional evidence that helps investigators reconstruct operational actions, mechanical settings, and chronological sequences during vehicle collision investigations.

66. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Physical evidence is generally recognized as more reliable than testimonial evidence because physical items provide objective, physical data. Unlike eyewitness testimony, which is vulnerable to memory distortion, perceptual errors, personal bias, misidentification, and deliberate perjury, physical evidence remains static and unaffected by psychological factors, making scientific observation objective and highly reliable.

67. (A) Gas Chromatography (GC)
Gas Chromatography (GC) is an analytical instrumental method that requires vaporizing and passing chemical samples through a chromatographic column using a carrier gas. The thermal vaporization and interaction with chemical stationary phases consume and permanently alter or destroy the analyzed sample portion. In contrast, stereomicroscopy, photography, and visual inspection preserve evidence completely intact.

68. (C) Fourier Transform Infrared Spectroscopy (FTIR)
Fourier Transform Infrared Spectroscopy (FTIR) is a non-destructive analytical technique widely used in trace evidence analysis. FTIR measures how chemical bonds absorb infrared radiation, producing characteristic molecular spectra without consuming or physically altering paint flakes, synthetic fibers, or polymer samples. This allows subsequent testing on the preserved trace evidence sample item.

69. (A) The sample accurately reflects the composition of the bulk lot.
A representative sample in forensic chemistry is a portion selected from a bulk seizure that accurately reflects the physical and chemical composition, purity, and characteristics of the entire population. Proper sampling protocols ensure that analytical conclusions derived from testing the representative portion hold true for the entire bulk seized material in court.

70. (D) Objective, detailing methodology, scientific findings, and their limits.
A forensic examination report prepared for court must maintain absolute scientific objectivity, clarity, and impartiality. The report must detail examination methodologies, analytical techniques, observed results, and scientific limits or uncertainties. Expert witnesses present factual findings without adopting investigative biases, taking sides, or declaring ultimate legal conclusions regarding guilt or legal innocence.

71. (B) Oral evidence is witness testimony, whereas documentary evidence comprises documents produced for judicial inspection.
In evidence law, oral evidence consists of statements made by witnesses under oath in court regarding facts in issue or relevant facts. Documentary evidence comprises documents, records, electronic files, or written instruments submitted directly to the court for judicial inspection. This distinction separates spoken witness testimony from physical or electronic documentary records.

Click Here to Buy book on Amazon

72. (C) It proves a fact directly without inference, such as an eyewitness seeing a crime.
Direct evidence establishes a fact in issue directly without requiring logical inference, deduction, or presumption. Primary examples include eyewitness testimony describing personal observation of a criminal act taking place. If believed by the trier of fact, direct evidence conclusively proves the fact asserted, distinguishing it from circumstantial evidence requiring logical inferences.

73. (A) I and II only
Establishing corpus delicti in a homicide investigation requires establishing two fundamental elements: proof of a human death and proof that the death resulted from a criminal act rather than natural, accidental, or suicidal causes. Confessions made to police officers do not form part of the physical corpus delicti structural elements.

74. (A) Reconstruction evidence
Bloodstain pattern analysis involves evaluating droplet spatial distributions, impact angles, motion trajectories, and cast-off patterns to reconstruct events during violent incidents. By determining impact directions, area of origin, and relative positions of participants, bloodstain pattern analysis provides vital reconstructive evidence that assists in re-creating physical actions at the primary crime scene location.

75. (B) Lifting with low-tack forensic tape
Lifting microscopic trace evidence using low-tack forensic tape is a non-destructive, highly effective collection technique for recovering fibers, hair, and particulate matter from fabric surfaces like car seats. The adhesive lifts delicate trace materials without pulling or damaging underlying substrate fabric fibers, preserving both the recovered trace material and underlying substrate.

76. (B) It can create a false association, implying direct contact when transfer occurred via an intermediary object.
Secondary transfer occurs when trace material is transferred from its original source to an intermediate surface and subsequently deposited onto another object or person. This process complicates forensic interpretation by potentially creating false associative links between individuals and scenes, implying direct physical contact when transfer occurred indirectly through an intermediate carrier object.

77. (A) Biological evidence
Biological evidence includes organic body fluids, tissues, and cellular materials recovered from crime scenes, such as blood, semen, saliva, urine, hair, and epithelial cells. A suspected semen stain on bedding is categorized as biological evidence. Forensic examination of biological materials involves serological testing followed by DNA profiling for personal source attribution.

78. (C) Chemical Evidence
Chemical evidence encompasses substances analyzed for their chemical identity, composition, purity, or molecular structure. Seized illicit drugs, controlled substances, pharmaceuticals, poisons, and accelerant residues represent chemical evidence. Forensic chemists conduct qualitative and quantitative chemical analyses on seized drugs to identify specific compounds and active constituent concentrations for court proceedings.

79. (A) P-2, Q-1, R-1, S-2
Visual examination under varied illumination and 3D laser scanning leave evidence completely unaltered, representing non-destructive techniques. Conversely, acid digestion for heavy metal detection chemically alters and consumes test samples. Firing a suspect firearm to obtain test bullets consumes ammunition, classifying both acid digestion and test firing as destructive forensic methods.

NODIA

80. (C) Evidence characteristics differ significantly and unexplainably from the reference sample.
Forensic exclusion occurs when analytical comparison demonstrates significant, unexplainable physical or chemical discrepancies between questioned crime scene evidence and a known reference sample. In forensic science, a definitive exclusion establishes that the questioned item did not originate from the reference source, regardless of whether other broad class traits match partially.

81. (A) I, III, II
Forensic examination levels provide ascending evidential weight based on individualizing power. Substance identification assigns an item to a general chemical category, representing basic probative value. Comparing class characteristics narrows evidence to a restricted group, providing

higher weight. Physical jigsaw fracture matching establishes absolute individualisation, proving unique common origin definitively.

82. (D) Transient evidence
Data stored in computer Random Access Memory (RAM) is volatile and immediately lost when system power is terminated. Because RAM content is fleeting and easily altered or destroyed, digital forensic examiners treat volatile RAM data as the digital equivalent of physical transient evidence, requiring immediate live digital acquisition.

83. (A) Primary documentary evidence
Under evidence law, primary documentary evidence consists of the original document itself produced for the inspection of the court. Submitting the actual forged check rather than a photocopy or electronic scan satisfies the best evidence rule, ensuring that paper substrate, ink, watermarks, and handwriting details can be fully examined forensically.

84. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Nuclear DNA profiling analyzes hypervariable genomic loci, yielding short tandem repeat (STR) profiles that are statistically unique to every individual, with the exception of monozygotic identical twins. Because an individual's nuclear DNA sequence is unique, matching biological evidence profiles against a reference sample provides forensic individualisation, linking material to a source.

85. (A) Negative control
A negative control is a known sample containing no target substance that is analyzed simultaneously alongside questioned evidence during chemical or presumptive testing. Running a negative control verifies that testing reagents and analytical equipment are free from contamination and do not produce false positive results, ensuring scientific analytical testing accuracy.

86. (D) The exact time of fibre transfer cannot be determined from the fibre alone.
Microscopic textile fiber analysis identifies fiber composition, synthetic polymer type, cross-sectional shape, and dye composition, establishing class associations. However, analyzing recovered fibers cannot reveal the exact chronological time or historical date when transfer occurred. Determining transfer timing requires surrounding contextual information, situational evidence, or corroborated statements rather than physical fiber properties alone.

87. (B) The Chain of Custody
Placing a recovered evidence item in an unsealed pocket without immediate, formal packaging and documentation severely compromises the chain of custody. The chain of custody requires continuous, documented accounting of evidence collection, handling, transfer, and storage. Unsealed, undocumented handling creates opportunities for loss, cross-contamination, or evidence substitution, jeopardizing legal court admissibility.

88. (D) I, II, III and IV
Admissibility of physical evidence in judicial proceedings requires satisfying foundational legal and scientific criteria. Evidence must be relevant to disputed facts in issue, legally seized in compliance with constitutional search protections, and backed by an unbroken chain of custody. Additionally, forensic analytical methods used must possess general acceptance within the relevant scientific community.

89. (D) Evidence from an independent source that supports or confirms other evidence.
Corroborative evidence consists of independent physical, biological, documentary, or testimonial evidence that strengthens, confirms, or supports existing evidence already presented in court. By providing separate verification from an independent source, corroborative evidence enhances the overall credibility and probative weight of primary evidence, assisting triers of fact during formal legal proceedings.

90. (A) An association where the suspect cannot be excluded, though others sharing those class traits are also included.
When physical evidence shares matching class characteristics with a reference sample but lacks unique individual traits—such as footwear tread patterns lacking distinct wear marks or cut imperfections—the forensic expert concludes a class association. This finding means the suspect or item cannot be excluded, while acknowledging that other sources sharing identical class characteristics are equally included.

Downloaded from www.pdf.tube

CHAPTER 10

Fingerprints: Types, Classification and Development Methods

1. The first systematic and official use of fingerprints for personal identification in India was initiated by Sir William Herschel in the 1850s in which of the following districts?
(A) Lucknow
(B) Hooghly
(C) Madras
(D) Bombay

2. Which Scottish physician published a letter in the journal 'Nature' in 1880, suggesting the use of fingerprints for identification and the tracing of criminals from latent prints left at crime scenes?
(A) Sir Francis Galton
(B) Sir Edward Richard Henry
(C) Alphonse Bertillon
(D) Dr. Henry Faulds

3. In the anatomy of human skin, the friction ridges that form fingerprints are primarily shaped by the undulations of which specific underlying layer?
(A) Dermal papillae
(B) Stratum corneum
(C) Stratum lucidum
(D) Subcutaneous tissue

4. During foetal development, at approximately what stage do the friction ridges on the fingers and palms begin to form permanently?
(A) 3 to 4 weeks of gestation
(B) 10 to 24 weeks of gestation
(C) 30 to 36 weeks of gestation
(D) Shortly after birth

5. The basic principles of fingerprint identification include the premise that fingerprints are permanent. Which of the following best describes this principle of permanence?
(A) Friction ridge patterns remain unchanged from birth until post-mortem decomposition, barring deep scarring.
(B) Friction ridges continuously regenerate with completely new patterns every seven years during cellular turnover.
(C) Friction ridge patterns can be permanently altered or erased by superficial cuts, abrasions, or minor skin injuries.
(D) Friction ridge dimensions remain identical in size and proportion from early infancy through fully mature adulthood.

6. Azizul Haque and Hem Chandra Bose, two Indian sub-inspectors of police, made a critical mathematical contribution to the development of which fingerprint classification system?
(A) The Vucetich System
(B) The Bertillonage System
(C) The Roscher System
(D) The Galton-Henry System

7. Read the following assertion and reason statements and select the correct option:
Assertion (A): Even identical twins have entirely different fingerprint patterns.
Reason (R): Friction ridge formation is governed solely by an individual's genetic code, which differs slightly even in identical twins.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

8. In a standard loop pattern, the friction ridges enter from one side of the print, recurve, and exit from which side?
(A) The opposite side from initial entry
(B) The upper edge of the fingertip area
(C) The same side as their entry point
(D) The exact center of the pattern core

9. What is the fundamental difference between an ulnar loop and a radial loop?
(A) An ulnar loop has two deltas, while a radial loop has one.

NODIA

(B) An ulnar loop opens toward the thumb, while a radial loop opens toward the little finger.
(C) An ulnar loop occurs only on the left hand, while a radial loop occurs only on the right hand.
(D) An ulnar loop opens toward the little finger, while a radial loop opens toward the thumb.

10. According to global population statistics, which fingerprint pattern is the most common?
(A) Loops
(B) Whorls
(C) Arches
(D) Accidental whorls

11. Which type of fingerprint pattern is characterised by ridges that enter from one side of the finger, rise in the center to form a peak or spike, and exit on the opposite side?
(A) Plain arch
(B) Tented arch
(C) Central pocket loop
(D) Double loop whorl

12. Consider the following statements regarding the anatomy of friction ridge skin:
I. Eccrine sweat glands are located within the dermis and their ducts open onto the tops of the friction ridges.
II. Sebaceous glands are highly concentrated on the palmar and plantar friction ridge surfaces.
III. The epidermis is the outer protective layer of the skin that contains no blood vessels.
Which of the above combinations is correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

13. Which of the following fingerprint patterns typically possesses at least two deltas and one core, and if an imaginary line is drawn between the two deltas, it must touch or cross at least one of the recurving ridges within the inner pattern area?
(A) Plain whorl
(B) Central pocket loop whorl
(C) Double loop whorl
(D) Accidental whorl

14. Which feature defines a central pocket loop whorl in distinction to a plain whorl?
(A) It possesses three distinct deltas instead of the standard two deltas present in plain whorls.
(B) It consists of two separate and distinct loop formations containing two separate pairs of shoulders.
(C) A line between its deltas touches no recurving ridges within the inner pattern area.
(D) It lacks a central pattern core completely, consisting solely of parallel ridge lines.

15. Match the scientist in List I with their primary contribution to fingerprint science in List II:
List I: (Scientist)
P. Sir Francis Galton
Q. Juan Vucetich
R. Dr. Edmond Locard
S. Salil Kumar Chatterjee
List II: (Contribution)
1. Developed edgeoscopy
2. Calculated the statistical uniqueness of fingerprints and described minutiae
3. Pioneered poroscopy for identification
4. Developed the fingerprint classification system used in Spanish-speaking countries
(A) P-2, Q-4, R-3, S-1
(B) P-4, Q-2, R-1, S-3
(C) P-3, Q-1, R-4, S-2
(D) P-2, Q-3, R-4, S-1

16. In fingerprint analysis, what is the 'core'?
(A) The point on a ridge at or in front of and nearest the center of the divergence of the type lines.
(B) The outermost ridge of the pattern area.
(C) The approximate center of the fingerprint pattern area.
(D) The intersection point of a bifurcation.

17. The 'delta' in a fingerprint pattern is best defined as:
(A) The absolute central focal point located at the peak recurve of a loop pattern.
(B) The ridge point directly at or nearest the divergence of the type lines.
(C) A small isolated island or dot ridge situated entirely outside the main pattern area.
(D) The sharpest, highest peak point along the central ridge of a tented arch pattern.

18. Consider the following statements regarding the Henry Primary Classification system:
I. The primary classification is based entirely on the presence of whorl patterns.

Click Here to Buy book on Flipkart

STUDYING FROM PDFs?

THINK AGAIN.

If you are studying only from PDFs,
you are wasting valuable time.

Research shows that learning from

PRINTED BOOKS has up to

4× HIGHER RETENTION

than studying from screens.

PRINT BOOK = BETTER MEMORY

PDF = LOWER RETENTION

Those who study from **PRINTED BOOKS**
move **AHEAD.**

Others are left **BEHIND**
in competition.

In competitive exams,
being average is not enough.

STAY ONE STEP AHEAD.

II. Fingers are paired, with the values of the even-numbered fingers forming the numerator.
III. If an individual has no whorls on any fingers, their primary classification ratio is 0/0.
IV. The right thumb is designated as finger number 1.

Which of the above statements are correct?
(A) I, II, and III
(B) II, III, and IV
(C) I, II, and IV
(D) I, III, and IV

19. In a forensic fingerprint examination, how is 'ridge counting' executed for a loop pattern?
(A) By counting ridges crossing a line from core to delta, excluding both focal points.
(B) By counting every continuous friction ridge present within the entire outer pattern area.
(C) By measuring the exact physical distance in millimetres between the core and the delta focal points.
(D) By counting all friction ridges intersecting a straight line drawn directly between two deltas.

20. Ridge tracing is a classification procedure applied specifically to which class of fingerprint patterns?
(A) Plain arches
(B) Tented arches
(C) Whorls
(D) Loops

21. When conducting ridge tracing on a whorl, if the traced ridge ends abruptly before reaching a point opposite the right delta, what is the standard procedural rule?
(A) Drop to the lower ridge inside and continue tracing opposite the right delta.
(B) Immediately halt tracing and automatically designate the whorl pattern as Meeting.
(C) Move up to the next higher ridge on the outside and proceed with tracing to the delta.
(D) Immediately reject the fingerprint pattern as damaged, incomplete, or unclassifiable.

22. In the context of whorl ridge tracing, if the traced ridge passes outside (below) the right delta, and there are three or more ridges between the traced ridge and the delta, how is the whorl classified?
(A) Inner (I)
(B) Meeting (M)
(C) Central (C)
(D) Outer (O)

23. What term is used to describe a single friction ridge that bifurcates and then shortly afterward converges back into a single ridge, creating a closed space?
(A) Spur or hook
(B) Lake or enclosure
(C) Crossover or bridge
(D) Island or short ridge

24. Which individual ridge characteristic (minutia) is defined as a very short ridge that is roughly as long as it is wide?
(A) Bifurcation
(B) Ridge ending
(C) Dot or island
(D) Bridge or crossover

25. Read the following assertion and reason statements and select the correct option:
Assertion (A): Latent fingerprints left at a crime scene are completely invisible to the naked eye under normal lighting conditions.
Reason (R): Latent fingerprints are primarily composed of eccrine sweat, which is largely water and lacks endogenous visible pigments.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

26. Which forensic scientist is credited with establishing the principle that personal identification could be achieved by examining the microscopic sweat pores along the friction ridges?
(A) Dr. Edmond Locard
(B) Sir Edward Richard Henry
(C) Alphonse Bertillon
(D) Nehemiah Grew

27. Edgeoscopy involves the identification of individuals through the study of:
(A) The structural spatial alignment and microscopic pore distribution along ridges.
(B) The specific morphological shapes and contour irregularities of ridge edges.
(C) The precise linear distance measured directly between the pattern core and delta.

Downloaded from www.pdf.tube

(A) I, II, and IV
(B) I, II, and III
(C) II, III, and IV
(D) I, III, and IV

46. After cyanoacrylate fuming, forensic scientists often apply a fluorescent dye stain to enhance the contrast of the white prints. Which of the following is a commonly used dye stain for this purpose?
(A) Amido Black
(B) Leucomalachite Green
(C) Rhodamine 6G
(D) Phenolphthalein

47. Which chemical method is considered highly effective for developing latent fingerprints on paper that has been previously wet, rendering water-soluble components like amino acids washed away?
(A) Ninhydrin
(B) Iodine fuming
(C) DFO (1,8-diazafluoren-9-one)
(D) Physical Developer (PD)

48. Small Particle Reagent (SPR) is uniquely useful in forensic investigations for developing latent prints on which type of surface?
(A) Absorbent, dry porous substrates like paper or cardboard.
(B) Unfixed epidermal tissue of living human skin surfaces.
(C) Wet non-porous surfaces like a vehicle exterior in rain.
(D) Severely oxidized and heavily rusted ferrous metal objects.

49. Read the following assertion and reason statements and select the correct option:
Assertion (A): DFO (1,8-diazafluoren-9-one) is often used before ninhydrin when processing paper evidence for latent prints.
Reason (R): DFO is highly fluorescent and generally develops more latent prints than ninhydrin alone, while not interfering with subsequent ninhydrin processing.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

50. Vacuum Metal Deposition (VMD) is an advanced technique for developing latent prints on difficult non-porous and semi-porous surfaces like plastic bags. Which two metals are traditionally evaporated in the vacuum chamber during this process?
(A) Iron and Copper
(B) Silver and Lead
(C) Aluminum and Titanium
(D) Gold and Zinc

51. When a latent fingerprint is developed using standard black powder on a contrasting surface, what is the most appropriate immediate next step before attempting to lift the print?
(A) Photograph the print in situ with a scale.
(B) Fume with cyanoacrylate to lock powder particles permanently in place.
(C) Vigorous brushing with a fiberglass brush to remove non-adherent powder.
(D) Press clear transparent fingerprint lifting tape directly over the print.

NODIA

52. Which material is most commonly used by field investigators to cast and preserve plastic fingerprints left in a three-dimensional matrix like putty or window caulking?
(A) Heavy-duty adhesive transparent lifting tape strips
(B) Solvent-based ninhydrin chemical aerosol spray
(C) Dental stone or Mikrosil casting silicone
(D) Flexible rubberized dark gelatin lifting sheets

53. What does the acronym AFIS stand for in the context of forensic science?
(A) Automated Fingerprint Identification System
(B) Applied Forensic Investigation & Recording System
(C) Analytical Fingerprint Imaging & Processing Software
(D) Automated Forensic Information & Archival System

54. When an unknown fingerprint is scanned into AFIS, the system's algorithm primarily searches the database based on the extraction of which features?
(A) The exact microscopic depth and cross-sectional pore diameter along ridges.
(B) The specific spectral coloration and chemical compound composition of residue.

37. When ninhydrin reacts with a latent fingerprint, it produces a visible colored compound. What is the standard color of the developed print and the specific name of this compound?
(A) Purple-blue; Ruhemann's purple
(B) Bright yellow; Silver chloride precipitate
(C) Deep brown; Iodine-starch chemical complex
(D) Opaque white; Polycyanoacrylate polymer

38. Match the chemical development method in List I with the target component of the latent print residue it reacts with in List II:
List I: (Chemical Development Method)
P. Ninhydrin
Q. Iodine Fuming
R. Silver Nitrate
S. Physical Developer
List II: (Target Component)
1. Chloride ions in sweat
2. Water-insoluble components (lipids/fats)
3. Amino acids
4. Lipids, fats, and oily substances (physical absorption)
(A) P-3, Q-4, R-1, S-2
(B) P-4, Q-3, R-2, S-1
(C) P-3, Q-1, R-4, S-2
(D) P-1, Q-4, R-3, S-2

39. Iodine fuming is a classical technique for latent print development. Which of the following is a critical characteristic of iodine-developed prints?
(A) They form highly stable permanent bonds with paper fibres and will never fade.
(B) They are fugitive and fade quickly unless photographed or fixed.
(C) They exhibit bright apple-green fluorescence under standard ambient white light.
(D) They require thermal baking inside an oven at 100°C to become visualised.

40. Which chemical reagent is commonly used to 'fix' iodine-developed fingerprints to prevent them from fading, turning them dark blue/black?
(A) Concentrated aqueous sodium hydroxide solution
(B) Commercial ninhydrin aerosol spray reagent
(C) Starch solution or alpha-naphthoflavone
(D) Acidified silver nitrate chemical solution

41. Arrange the following levels of friction ridge detail in the correct sequence from the macroscopic overall pattern to the finest microscopic features:
I. Pores and ridge edges (Level 3)
II. Overall ridge flow and pattern type (Level 1)
III. Minutiae points such as bifurcations and endings (Level 2)
Which of the following represents the correct sequence?
(A) I, II, III
(B) II, III, I
(C) III, II, I
(D) II, I, III

42. In the silver nitrate method of fingerprint development, silver nitrate reacts with chloride ions in sweat to form silver chloride. What environmental condition is subsequently required to make this silver chloride visible as a dark brown or black print?
(A) Exposure to ultraviolet light or sunlight
(B) Incubation under sub-zero freezing temperatures
(C) Enclosure in high relative humidity above 80%
(D) Direct exposure to concentrated cyanoacrylate fumes

43. Cyanoacrylate ester fuming is widely used to develop latent prints on non-porous surfaces. What is the common commercial name for cyanoacrylate?
(A) Cellophane
(B) Superglue
(C) Teflon
(D) Bakelite

44. During cyanoacrylate fuming, the cyanoacrylate vapors polymerise on the latent print residue. What color is the resulting developed fingerprint before any secondary dye staining?
(A) Purple
(B) White
(C) Black
(D) Brown

45. Consider the following statements regarding the Cyanoacrylate fuming technique:
I. It is primarily used for non-porous surfaces such as glass, metal, and plastic.
II. The fuming chamber typically requires a high relative humidity (around 80%) for optimal polymerisation.
III. The process can be accelerated by heating the liquid cyanoacrylate.
IV. Prints developed with cyanoacrylate can easily be washed off with water, making them highly fragile.
Which of the above statements are correct?

Click Here to Buy book on Amazon

IV. Epidermal skin shedding naturally replaces the ridge pattern with a new one every few months.

Which of the above statements are correct?
(A) I and III
(B) II and IV
(C) I, II, and III
(D) I, III, and IV

83. When photographing a latent fingerprint before lifting, the camera's sensor (or film plane) must be aligned in what orientation relative to the surface bearing the print?
(A) Parallel to the surface (90-degree angle of view)
(B) At a 45-degree angle
(C) At a 30-degree angle to catch the shadow
(D) The angle does not matter as long as the print is visible

84. Which statement about the chemical development of latent prints using the Physical Developer (PD) is correct?
(A) PD is sequentially applied as the initial step prior to all other chemical reagents.
(B) PD functions primarily by chemically reacting with residual aqueous content in sweat.
(C) A silver aqueous reagent reacting with lipids and water-insoluble residues.
(D) Latent prints developed via PD reagents characteristically turn bright crimson red.

85. Match the fingerprint pattern in List I with its minimum delta requirement in List II:
List I: (Fingerprint Pattern)
P. Plain Arch
Q. Ulnar Loop
R. Plain Whorl
S. Accidental Whorl
List II: (Minimum Delta Requirement)
1. One delta
2. Zero deltas
3. Two or more deltas
4. Two deltas
(A) P-2, Q-1, R-4, S-3
(B) P-1, Q-2, R-3, S-4
(C) P-2, Q-1, R-3, S-4
(D) P-4, Q-3, R-2, S-1

86. Find the odd one out among the following chemical reagents based on the type of surfaces they are primarily used to process:
(A) Ninhydrin
(B) DFO (1,8-diazafluoren-9-one)
(C) Physical Developer (PD)
(D) Cyanoacrylate (Superglue)

87. Read the following statements and select the correct option:
Statement I: Whorl tracings are categorised as Inner, Meeting, or Outer.
Statement II: If the traced ridge from the left delta passes inside the right delta by three or more ridges, it is classified as an Outer (O) whorl.
(A) Both Statement I and Statement II are correct.
(B) Both Statement I and Statement II are incorrect.
(C) Statement I is correct but Statement II is incorrect.
(D) Statement I is incorrect but Statement II is correct.

88. A forensic expert notes a "spur" during a fingerprint examination. This is best described as:
(A) A single ridge splitting into two parallel branches before reuniting into one.
(B) An intersecting ridge traversing across an adjacent ridge at a right angle.
(C) A bifurcation with an extremely short branch ending abruptly.
(D) An isolated dot or short island ridge situated completely inside an enclosure.

89. Which of the following is NOT a standard, widely accepted classification system or terminology used in modern friction ridge identification?
(A) Henry Classification System for Fingerprints
(B) Galton Details Minutiae Classification
(C) Vucetich System of Pattern Identification
(D) Bertillon Anthropometry System

90. When a crime scene investigator encounters a wet drinking glass with suspected latent prints, which of the following is the most appropriate and effective enhancement method?
(A) Small Particle Reagent (SPR)
(B) Regular black magnetic powder
(C) Ninhydrin dipping
(D) Iodine fuming

NODIA

(C) The total physical length and width measurements of the finger from joint to tip.
(D) The spatial location coordinates and orientation angles of minutiae points.

55. In India, the National Automated Fingerprint Identification System (NAFIS) project is managed and implemented centrally by which organization?
(A) Central Bureau of Investigation (CBI)
(B) National Crime Records Bureau (NCRB)
(C) National Investigation Agency (NIA)
(D) Directorate of Forensic Science Services (DFSS)

56. Consider the following statements regarding AFIS / NAFIS operations:
I. The system generates a candidate list of potential matches based on algorithmic scoring.
II. The system makes the final definitive legal identification without any human intervention.
III. A qualified fingerprint expert must manually examine the candidate prints to verify and declare a definitive match.
Which of the above combinations is correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

57. The palmar surface of the human hand is anatomically divided into specific areas for forensic classification. Which term describes the large pad at the base of the thumb?
(A) Hypothenar area
(B) Interdigital area
(C) Calcar area
(D) Thenar area

58. The friction ridge area located directly beneath the fingers (index, middle, ring, and little fingers) on the palm is known as the:
(A) Interdigital area
(B) Thenar palmar area
(C) Hypothenar region
(D) Plantar sole surface

59. The study and comparison of footprints (friction ridges on the soles of the feet) is governed by which fundamental scientific principle?
(A) Footprints lack individual minutiae, so identification relies on overall boundary shape.
(B) Plantar friction ridge skin is unique and permanent, like palmar skin.
(C) Footprint ridge configurations alter significantly throughout life due to weight pressure.
(D) Plantar surfaces lack functional sweat glands, preventing latent print deposition.

60. On a human footprint, the large friction ridge area corresponding to the heel is anatomically designated as the:
(A) Hallucal area
(B) Calcar area
(C) Plantar arch
(D) Thenar area

61. If a crime scene investigator finds a distinct latent print in blood on a tile floor, which chemical reagent is most appropriate for enhancing this protein-rich blood print?
(A) Amido Black
(B) Ninhydrin
(C) Silver Nitrate
(D) Small Particle Reagent

62. Match the anatomical term of the friction ridge skin in List I with its correct location in List II:
List I: (Anatomical Term)
P. Thenar
Q. Hypothenar
R. Hallucal
S. Calcar
List II: (Location)
1. Base of the big toe on the foot
2. Heel region of the foot
3. Base of the thumb on the palm
4. Ulnar side of the palm (below the little finger)
(A) P-3, Q-4, R-1, S-2
(B) P-4, Q-3, R-2, S-1
(C) P-1, Q-2, R-3, S-4
(D) P-3, Q-1, R-4, S-2

63. Which type of fingerprint pattern is represented by the Henry classification notation "W"?
(A) Tented Arch pattern
(B) Standard Ulnar Loop
(C) Radial Loop pattern
(D) Whorl (Plain)

64. In the Henry Primary Classification system, if a person has whorls on their Right Thumb, Right Index, and Right Middle fingers, and loops or

Downloaded from www.pdf.tube

arches on all other fingers, what is the numerical value assigned to the Right Middle finger (which is finger number 3)?
(A) 16
(B) 8
(C) 4
(D) 0

65. Based on the rules of Henry's Primary Classification, the fraction is calculated as (1 + Sum of even-numbered fingers) / (1 + Sum of odd-numbered fingers). If an individual has loops on every finger, what is their primary classification?
(A) 0/0
(B) 1/1
(C) 32/32
(D) 1/0

66. When examining a questioned document for latent prints, an investigator must take care to preserve both the prints and the document's inks. Which non-destructive optical technique should be employed first before any chemical processing?
(A) Full immersion liquid ninhydrin chemical dip processing
(B) Thermal iodine vapour fuming in a sealed glass chamber
(C) Aqueous silver nitrate chemical spray reagent application
(D) Alternate Light Source (ALS) optical examination

67. Which term describes the small, secondary creases commonly found on the palms and fingers, which are permanent but generally used only as supplemental features in identification?
(A) Flexion creases
(B) Friction ridges
(C) Dermal papillae
(D) Epidermal ridges

68. Which of the following represents the correct sequence for chemical development of latent fingerprints on porous paper, assuming all methods are to be used sequentially on the same document?
(A) Ninhydrin → Iodine Fuming → Silver Nitrate → Physical Developer
(B) Iodine Fuming → Ninhydrin → Silver Nitrate → Physical Developer
(C) Physical Developer → Silver Nitrate → Ninhydrin → Iodine Fuming
(D) Silver Nitrate → Iodine Fuming → Physical Developer → Ninhydrin

69. A 'crossover' minutia is most accurately defined as:
(A) A short ridge connecting two parallel friction ridges.
(B) A single, isolated friction ridge that is small in overall length.
(C) A continuous friction ridge line that terminates abruptly at a point.
(D) A junction where three separate ridges meet at a 120-degree orientation.

70. Identify the incorrect statement regarding the handling and packaging of evidence bearing latent fingerprints:
(A) Items should be handled with clean gloves to prevent contamination.
(B) Items should be secured by their edges or non-porous areas where prints are unlikely to be.
(C) Documents should be placed in rigid cardboard or paper envelopes, not plastic.
(D) Items should be wrapped tightly in plastic bags to prevent the prints from rubbing off.

71. Read the following assertion and reason statements and select the correct option:
Assertion (A): Transparent lifting tape is the standard tool for lifting dusted latent fingerprints from smooth surfaces.
Reason (R): The adhesive on the lifting tape undergoes a chemical reaction with the fingerprint powder, creating a permanent chemical bond.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

NODIA

72. Which of the following terms is NOT a recognized sub-classification of the loop fingerprint pattern?
(A) Ulnar loop
(B) Radial loop
(C) Tented loop
(D) Central pocket loop

73. In terms of fingerprint individualisation in Indian jurisprudence, what is the generally accepted minimum number of matching minutiae (Galton details) traditionally required by experts to

declare a positive identification, though no rigid statutory minimum exists?
(A) 2 to 4 points
(B) 8 to 12 points
(C) 30 to 40 points
(D) Minimum 50 points

74. Which of the following is an example of an 'accidental' whorl pattern?
(A) A pattern combining two different pattern types with two or more deltas.
(B) A standard pattern formed by the simple combination of a loop and plain arch.
(C) A single-delta pattern featuring ridges forming continuous circles around a core.
(D) A severely distorted or smudged print matrix that cannot be legibly classified.

75. Arrange the following fundamental steps of the NAFIS/AFIS workflow in the correct operational sequence:
I. Manual Verification by a Fingerprint Expert
II. Extraction of Minutiae and Pattern Data
III. Scanning or Importing of the Fingerprint Image
IV. Algorithmic Database Search and Generation of Candidate List
Which of the following represents the correct operational sequence?
(A) III, II, IV, I
(B) III, IV, II, I
(C) II, III, IV, I
(D) IV, III, II, I

76. The 'Locard Exchange Principle' is a foundational concept in forensic science. How is it most directly applied to fingerprint evidence?
(A) It dictates the strict mathematical principles behind primary fingerprint classification.
(B) Contact leaves friction ridge residue at scenes and carries trace materials away.
(C) It governs embryological ridge morphogenesis and prenatal friction skin development.
(D) It defines specific stoichometric chemical reactions between ninhydrin and amino acids.

77. Which of the following correctly pairs a chemical reagent with the specific color of the developed latent print it produces?
(A) Silver Nitrate – Black/Brown under UV
(B) Ninhydrin Reagent – Bright White Print
(C) Cyanoacrylate Fuming – Deep Purple Print
(D) Iodine Vapor – Fluorescent Green Print

78. Consider the following statements regarding palm prints in forensic investigations:
I. Palm prints account for a significant percentage of latent prints found at crime scenes.
II. Palm prints possess friction ridges and minutiae just like fingertips.
III. Palm prints cannot be searched or stored in modern automated systems like NAFIS.
Which of the above combinations is correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

79. A crime scene investigator discovers a latent print on a piece of adhesive tape (on the sticky side). Which specialized chemical suspension is commonly used to develop prints on the adhesive side of tape?
(A) Fine magnetic powder suspension reagent
(B) Chemical iodine vapor fuming formulation
(C) Acidified aqueous silver nitrate solution
(D) Sticky-side powder or Gentian Violet

80. The primary purpose of a 'hinge lifter' in crime scene processing is to:
(A) Mechanically force open doors or windows to locate hidden latent prints.
(B) Cast and preserve detailed three-dimensional plastic prints left in mud or soil.
(C) Lift a dusted fingerprint and protectively seal it with attached backing.
(D) Deliver vaporized chemical fumes evenly across fragile porous paper documents.

81. Which fingerprint pattern is theoretically defined as possessing no core and no delta?
(A) Tented arch
(B) Plain arch
(C) Radial loop
(D) Central pocket loop

82. Consider the following statements regarding the uniqueness and permanence of fingerprints:
I. Scarring from a deep burn that damages the dermal papillae can permanently alter a fingerprint.
II. Warts on the fingers do not affect the friction ridge pattern in any way.
III. As a person grows from childhood to adulthood, the friction ridges expand in size but retain the exact same minutiae arrangement.

Click Here to Buy book on Flipkart

(D) The relative depth and width variations of the furrows separating friction ridges.

28. A fingerprint left in a pliable medium such as wet paint, wax, soap, or putty is technically classified as a:
(A) Latent print residue
(B) Plastic print
(C) Patent visible print
(D) Inked standard print

29. Which of the following represents the correct standard sequence for obtaining the ridge count in a loop pattern?
(A) Locate core → Locate delta → Draw an imaginary straight line between them → Count the intersecting ridges excluding the core and delta
(B) Locate delta → Locate core → Count the intersecting ridges including the core and delta → Draw imaginary line
(C) Draw imaginary line → Locate core → Locate delta → Count the ridges
(D) Count the ridges → Locate core → Locate delta → Draw imaginary line

30. A patent fingerprint is best described as:
(A) An invisible print requiring chemical or physical development to be visualised clearly.
(B) A three-dimensional moulded print left in soft materials such as fresh clay or wax.
(C) A visible print formed by transferring contaminants like blood, ink, or grease.
(D) An invisible print composed exclusively of natural eccrine and sebaceous secretions.

31. Natural eccrine sweat, which forms the basis of most latent fingerprints deposited from the palms and fingertips, is predominantly composed of:
(A) Complex organic amino acids
(B) Long-chain lipids and non-polar fats
(C) Nitrogenous urea and metabolic waste
(D) Water (approximately 98-99%)

32. Sebaceous secretions found in latent fingerprints on a crime scene typically originate from:
(A) Secretions from eccrine sweat glands located natively along friction ridges of fingertips.
(B) Chemical decomposition of natural aqueous eccrine secretions upon ambient atmospheric exposure.
(C) Touching skin areas rich in sebaceous glands, such as the face, hair, or scalp.
(D) Physical deposition resulting from contact between fingertips and particulate atmospheric dust.

33. The powder dusting method for developing latent fingerprints works primarily on the principle of:
(A) Irreversible chemical bonding between active functional reagents and latent amino acid residues.
(B) Physical adherence of powder to moisture and oily components of friction ridge residue.
(C) Ionic interaction and covalent complex formation involving inorganic chloride ions in sweat.
(D) Rapid chemical polymerisation triggered immediately upon surface contact with residual water.

NODIA

34. Consider the following statements regarding fingerprint powders:
I. Magnetic powders are applied using a Magna brush, which lacks standard bristles, thus preventing mechanical damage to fragile prints.
II. Fluorescent powders are visualised using an alternate light source or UV light.
III. Traditional black fingerprint powder usually contains carbon black or graphite.
Which of the above combinations is correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

35. For which type of surface is the application of magnetic fingerprint powder most effective and appropriate?
(A) Smooth, non-porous surfaces such as glass, plastic, or coated paper.
(B) Highly porous untreated paper substrates such as newsprint or cardboard.
(C) Water-soaked, highly absorbent porous materials like damp corrugated boxes.
(D) Unfinished, heavily textured or coarse rough-sawn timber wooden surfaces.

36. Ninhydrin is a chemical reagent commonly used to develop latent fingerprints on porous surfaces like paper. What specific component of the latent print residue does ninhydrin react with?
(A) Chloride ions
(B) Sebaceous oils
(C) Amino acids
(D) Water

ANSWERS

1. (B) Hooghly
Sir William Herschel, a British civil servant serving in India during the mid-nineteenth century, pioneered the practical application of friction ridge skin patterns. In 1858, while working as a magistrate in the Hooghly district of West Bengal, he initiated the systematic recording of handprints and fingerprints on official legal contracts to prevent forgery and impersonation.

2. (D) Dr. Henry Faulds
Dr. Henry Faulds, a Scottish medical missionary based in Japan, conducted early research on human friction ridge details during the late nineteenth century. In October 1880, he published a landmark letter in the journal Nature, proposing the potential value of fingerprints in crime scene investigations for identifying suspects through latent ridge impressions left on objects.

3. (A) Dermal papillae
Friction ridges on human digits and palms are created by structural interactions between the epidermis and dermis layers of skin. Specifically, the dermal papillae are microscopic peg-like projection elevations located along the upper dermis layer. These papillae form rows that dictate the precise surface arrangement, topography, and boundaries of the overlying epidermal friction ridge patterns.

4. (B) 10 to 24 weeks of gestation
Human friction ridge skin configuration develops during early intrauterine embryonic growth. Volar pads begin forming on the foetal digits around the tenth week of gestation. Ridge development progresses through rapid cell proliferation and differentiation until the patterns become fully fixed and permanently established in the dermal layer by approximately the twenty-fourth week of gestation.

5. (A) Friction ridge patterns remain unchanged from birth until post-mortem decomposition, barring deep scarring.
The principle of permanence in dactyloscopy establishes that friction ridge patterns on human hands and feet remain immutable throughout an individual's lifetime. Formed during embryonic development, these patterns persist without naturally changing their structural arrangements from birth through adulthood until post-mortem decomposition, unless physical trauma penetrates deep into the underlying dermal papillae layer.

NODIA

6. (D) The Galton-Henry System
Azizul Haque and Hem Chandra Bose were Indian police officers serving under Sir Edward Richard Henry in the late nineteenth century. They developed the mathematical formulas and sub-classification architecture necessary to systematically organize large fingerprint repositories. Their crucial work formed the foundation of the Galton-Henry Classification System adopted globally for law enforcement record-keeping.

7. (C) Assertion (A) is true but Reason (R) is false.
Monozygotic twins share identical genetic sequences, yet their fingerprints differ distinctly due to stochastic developmental factors in utero. While genetics influences general pattern categories, actual friction ridge morphogenesis is shaped by micro-environmental forces like umbilical fluid dynamics, physical pressures, and localized growth rates, proving that friction ridge detail is non-heritable and physically unique.

8. (C) The same side as their entry point
A loop is a specific category of friction ridge pattern in which ridge lines enter from one side of the impression, curve backward upon themselves to form a recurve, and exit or tend to exit on the exact same side from which they entered. This distinctive structural behavior requires a single delta.

9. (D) An ulnar loop opens toward the little finger, while a radial loop opens toward the thumb.
Loop patterns are designated based on the anatomical orientation of the forearm bones toward which their ridges open. An ulnar loop features ridges that flow and open toward the ulna bone, which aligns with the little finger. Conversely, a radial loop features ridges that open toward the radius bone, aligning with the thumb.

10. (A) Loops
Global forensic statistics indicate that friction ridge patterns fall into three major morphological classes: loops, whorls, and arches. Loops constitute the most prevalent pattern, accounting for approximately 60 to 65 percent of all human fingerprint impressions. Whorls represent roughly 30 to 35 percent, while arches are the rarest pattern, comprising only 5 percent.

11. (B) Tented arch
A tented arch is a variant of the arch pattern class where friction ridges enter from one side and exit on the opposite side. Unlike a plain arch, a tented arch is defined by a sharp central thrust, spike, or angle where the middle ridges push upward dramatically, creating a tent-like profile.

12. (C) I and III only
Friction ridge skin lacks sebaceous oil glands, containing exclusively eccrine sweat glands within the dermis whose ducts discharge sweat directly onto ridge surfaces. Additionally, the outer layer of skin, known as the epidermis, functions as an avascular protective barrier that relies on nutrients diffusing from the blood vessels present within the lower dermal layer.

13. (A) Plain whorl
A plain whorl consists of at least two deltas and an inner core surrounded by continuous recurving ridge lines. In a standard plain whorl, drawing an imaginary straight line between the two deltas forces the line to intersect or touch at least one of the recurving ridges forming the central pattern area.

14. (C) A line between its deltas touches no recurving ridges within the inner pattern area.
Both plain whorls and central pocket loop whorls contain two deltas. However, in a central pocket loop whorl, an imaginary straight line drawn between the two deltas does not touch or cross any of the inner recurving ridges forming the central core, distinguishing it mathematically from a plain whorl configuration.

15. (A) P-2, Q-4, R-3, S-1
Sir Francis Galton established the statistical uniqueness of friction ridges and defined minutiae. Juan Vucetich formulated the primary classification system widely used across Spanish-speaking nations. Dr. Edmond Locard pioneered poroscopy, analyzing sweat pores for identification. Salil Kumar Chatterjee developed edgeoscopy, evaluating structural ridge margin contours and irregularities to aid forensic friction ridge comparisons.

16. (C) The approximate center of the fingerprint pattern area.
In fingerprint classification, the core represents the precise focal point positioned at or near the approximate center of a pattern loop or whorl. In loop patterns, the core is designated on the innermost recurving ridge, serving as an essential reference point for executing standardized ridge counting and pattern alignment procedures.

17. (B) The ridge point directly at or nearest the divergence of the type lines.
The delta is a critical triangular focal point within friction ridge patterns. It is located at or directly in front of the divergence point where two parallel ridge lines, known as type lines, separate to enclose the pattern area. It is used as a primary anchor for ridge tracing and counting.

18. (C) I, II, and IV
The Henry Primary Classification assigns numerical values based strictly on whorl presence across ten numbered fingers, starting with the right thumb as finger one. Even-numbered fingers form the numerator, while odd-numbered fingers form the denominator. An arbitrary base value of one is added to both, yielding 1/1 when no whorls exist.

19. (A) By counting ridges crossing a line from core to delta, excluding both focal points.
Ridge counting provides a quantitative measure for loop classification. The examiner draws an imaginary straight line connecting the pattern core to the delta. Every friction ridge intersecting this imaginary line is counted. Crucially, neither the core itself nor the delta focal point is included in the final numerical ridge count sum.

20. (C) Whorls
Ridge tracing is a specialized classification technique applied exclusively to whorl patterns. The process tracks a friction ridge originating from the left delta across the lower pattern area toward the right delta to evaluate spatial position, resulting in sub-classification categories designated as Inner, Meeting, or Outer based on ridge count differences.

Downloaded from www.pdf.tube

21. (A) Drop to the lower ridge inside and continue tracing opposite the right delta.
Standardized whorl ridge tracing rules dictate how abrupt ridge terminations are handled during analysis. If the specific friction ridge being traced from the left delta comes to an end before reaching the right delta, the examiner must drop down to the next lower underlying ridge and continue tracing toward the right delta focal point.

22. (D) Outer (O)
During whorl ridge tracing, a ridge starting at the left delta is followed toward the right delta. If the traced ridge passes outside or below the right delta, and three or more ridges separate the traced ridge from that delta, the whorl pattern is officially designated as an Outer whorl.

23. (B) Lake or enclosure
Individual friction ridge characteristics, known as minutiae, form unique pattern structures. When a single ridge splits into two separate branches through bifurcation and those branches rejoin shortly afterward to re-establish a single continuous ridge, the enclosed oval or circular void created between the branches is termed an enclosure or lake.

24. (C) Dot or island
Minutiae represent local ridge disruptions along friction skin. An island or dot is defined as an extremely short, isolated friction ridge segment whose overall length is approximately equal to its width. It stands completely independent between two adjacent parallel ridges without making physical contact or connecting to surrounding ridge structures.

25. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Latent fingerprints deposited on crime scene evidence are invisible under standard lighting conditions because they are formed by transparent, colorless sweat secretions from eccrine glands. Since this perspiration consists of over 98 percent clear water and trace inorganic salts without visible biological pigments, chemical or physical visualization methods are necessary.

26. (A) Dr. Edmond Locard
Dr. Edmond Locard, a pioneering French forensic scientist, established poroscopy in 1912 as a specialized technique for personal identification. He demonstrated that the microscopic size, shape, frequency, and relative spatial distribution of individual eccrine sweat pores positioned along friction ridges are unique to every person and remain strictly immutable throughout life.

27. (B) The specific morphological shapes and contour irregularities of ridge edges.
Edgeoscopy is a specialized Level 3 friction ridge examination discipline introduced by Indian forensic scientist Salil Kumar Chatterjee. It involves systematically evaluating the specific morphological variations, contour irregularities, spatial alignments, and microscopic structural edge shapes along individual friction ridges, providing valuable individualizing details that supplement standard minutiae comparisons during forensic identification.

28. (B) Plastic print
A plastic fingerprint is a distinct three-dimensional friction ridge impression created when a finger contacts a soft, moldable substrate. Materials such as wet paint, unheated wax, soft soap, fresh putty, or caulk yield under mechanical pressure, retaining the exact inverted volumetric topography, structural depth, and ridge features of the friction skin.

NODIA

29. (A) Locate core → Locate delta → Draw an imaginary straight line between them → Count the intersecting ridges excluding the core and delta
Determining the ridge count of a loop pattern requires a systematic protocol. The examiner first identifies the precise core location, then identifies the corresponding delta. An imaginary straight line is established connecting these two focal points, and every intervening friction ridge crossing this line is counted, excluding both initial focal points.

30. (C) A visible print formed by transferring contaminants like blood, ink, or grease.
A patent fingerprint is an easily visible two-dimensional impression formed when friction ridge skin coated with foreign liquid or particulate substances touches a surface. Materials like blood, printer ink, grease, oil, paint, or dirt transfer directly to the receiving substrate, creating a visible pattern that can be photographed without chemical development.

90. (A) Small Particle Reagent (SPR)
When latent fingerprints are deposited on wet non-porous evidence like a wet drinking glass, conventional powders fail due to surface water interference, while dry fuming is compromised. Small Particle Reagent is uniquely designed as a liquid suspension containing molybdenum disulfide that adheres physically to fatty lipids on wet surfaces without requiring prior drying.

Click Here to Buy book on Amazon

a deep blue starch-iodine inclusion complex. Alternatively, applying alpha-naphthoflavone reagent reacts chemically with absorbed iodine to form a highly stable, permanent blue-black image.

41. (B) II, III, I
Fingerprint friction ridge details are classified into three hierarchical levels. Level 1 encompasses overall ridge flow and macro-pattern category like loops, whorls, or arches. Level 2 details include specific minutiae formations such as ridge endings, bifurcations, dots, and continuous islands. Level 3 comprises microscopic features including pore structure and fine ridge edge morphology.

42. (A) Exposure to ultraviolet light or sunlight
In silver nitrate processing, aqueous silver nitrate reacts with sodium chloride present in sweat residue, forming light-sensitive silver chloride. When this reaction product is exposed to an ultraviolet light source or direct sunlight, silver chloride undergoes photochemical reduction to elemental silver, transforming the latent print into a visible dark brown or black image.

43. (B) Superglue
Cyanoacrylate fuming is a staple forensic technique used to develop latent impressions on non-porous materials. Cyanoacrylate ester is commercially manufactured and marketed as Superglue. When vaporized inside a controlled environment, its volatile molecules react with trace moisture and eccrine residue, polymerizing along friction ridge lines to form a stable white deposit.

44. (B) White
During cyanoacrylate fuming, vaporized alkyl cyanoacrylate monomers interact with catalytic moisture and chemical initiators in fingerprint residue. This initiates a rapid addition polymerisation reaction that produces polycyanoacrylate. The resulting synthetic polymer settles directly along the friction ridges, creating a durable, opaque white deposit that visualizes the print prior to dye staining.

45. (B) I, II, and III
Cyanoacrylate fuming is effective on non-porous items like plastic, glass, and metal. Maintaining approximately 70 to 80 percent relative humidity inside the processing chamber is critical because water acts as a catalyst for polymerisation. Heating liquid cyanoacrylate accelerates vapor generation. Crucially, the resulting polycyanoacrylate polymer forms a durable, permanent white shell.

46. (C) Rhodamine 6G
After cyanoacrylate fuming generates white polycyanoacrylate deposits on non-porous evidence, fluorescent dye stains such as Rhodamine 6G are applied. Rhodamine 6G readily absorbs specific wavelengths from alternate light sources or forensic lasers and fluoresces intensely, yielding outstanding optical contrast when visualising latent ridge impressions against multicolored or reflective background surfaces.

47. (D) Physical Developer (PD)
When paper evidence becomes wet, water-soluble amino acids and salts dissolve and wash away, rendering ninhydrin and DFO ineffective. Physical Developer is an aqueous silver nitrate-based reagent that targets water-insoluble lipid components such as fats, oils, and waxes that remain bound to paper fibers, making it the preferred chemical recovery method for water-damaged items.

48. (C) Wet non-porous surfaces like a vehicle exterior in rain.
Small Particle Reagent is a liquid suspension consisting of molybdenum disulfide particles suspended in a detergent solution. The dark particles physically adhere to fatty and oily residues in latent prints. It is uniquely effective for developing latent prints on wet, smooth, non-porous surfaces, such as wet glass, plastic, or outdoor vehicle bodies.

49. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
In sequential chemical processing of porous evidence, DFO (1,8-diazafluoren-9-one) is applied before ninhydrin. DFO reacts with amino acids to produce fluorescent products under green illumination, consistently developing more faint latent prints than ninhydrin alone. Crucially, DFO treatment does not destroy remaining amino acids, permitting subsequent ninhydrin processing on the same item.

NODIA

be tightly wrapped in plastic bags. Non-porous plastic creates a sealed microclimate that traps condensed moisture, promoting bacterial decay and fungal growth that destroys fragile organic eccrine residue, while friction against plastic wall surfaces physically wipes away delicate latent impressions.

71. (C) Assertion (A) is true but Reason (R) is false.
Transparent adhesive lifting tape is the primary tool used to recover dusted latent fingerprints from smooth surfaces. However, the lifting mechanism relies purely on physical surface adhesion between the pressure-sensitive adhesive film and the powder particles. No chemical reaction or chemical bonding takes place between the tape adhesive matrix and the fingerprint powder.

72. (C) Tented loop
Fingerprint pattern taxonomy recognizes specific categories and sub-types. The loop pattern class is sub-divided strictly into ulnar loops and radial loops based on ridge flow orientation toward forearm bones. Central pocket loops are a sub-type of whorls. Tented loop is a non-existent classification term combining two separate pattern categories, arches and loops.

73. (B) 8 to 12 points
Although Indian statutory law and the Indian Evidence Act do not mandate a fixed numerical threshold for minutiae matching, forensic practices in Indian fingerprint bureaus traditionally accept a minimum standard of 8 to 12 matching Galton details. These unexplainable matching points of similarity establish positive individual identification in judicial court proceedings.

74. (A) A pattern combining two different pattern types with two or more deltas.
An accidental whorl is a complex fingerprint pattern that does not conform to standard loop, plain arch, tented arch, or regular whorl definitions. It consists of a combination of two distinct pattern types, such as a loop and a tented arch, and contains two or more deltas, forming an atypical ridge configuration.

75. (A) III, II, IV, I
The operational workflow in automated fingerprint systems like NAFIS follows a logical linear sequence. First, the fingerprint image is scanned or imported (III). Next, feature extraction algorithms detect minutiae and pattern data (II). Then, automated search routines compare these features against the database to produce candidate matches (IV). Finally, a certified fingerprint expert manually verifies candidate prints (I).

76. (B) Contact leaves friction ridge residue at scenes and carries trace materials away.
Locard's Exchange Principle asserts that every physical contact leaves a trace. Applied to fingerprint science, whenever human hands or feet make physical contact with an object or surface, sweat, oils, and cellular matrix residues are transferred to the target substrate, while minute environmental contaminants present on the surface are simultaneously picked up by the skin.

77. (A) Silver Nitrate – Black/Brown under UV
Silver nitrate reacts with chloride ions in sweat to form silver chloride, which turns dark brown or black upon exposure to ultraviolet light or ambient sunlight due to photochemical silver reduction. In contrast, ninhydrin forms Ruhemann's purple, cyanoacrylate produces an opaque white polymer deposit, and iodine vapor generates a fugitive yellowish-brown impression.

78. (A) I and II only
Palm prints represent a substantial proportion of latent friction ridge evidence recovered from crime scenes. Palmar surfaces possess the same dermal papillae structure, friction ridges, sweat pores, and minutiae details as fingertips. Modern automated systems like NAFIS feature dedicated palmar database modules designed specifically to store, search, and match palmar friction ridge impressions.

79. (D) Sticky-side powder or Gentian Violet
Developing latent fingerprints on the sticky adhesive matrix of tape requires specialized formulations. Standard dry powders clump and ruin adhesive surfaces. Specialized suspensions such as sticky-side powder (a mixture of dark powder, liquid detergent, and water) or Gentian Violet dye selectively stain lipid components without adhering destructively to the background adhesive layer.

Downloaded from www.pdf.tube

60. (B) Calcar area
In podoscopy and forensic footprint examination, the anatomical regions of the human plantar sole are systematically designated. The calcar area corresponds to the heel region of the foot. It contains durable friction ridge skin overlying the calcaneus bone, exhibiting individual minutiae arrangements, unique ridge flows, and flexion creases for identification.

61. (A) Amido Black
Amido Black is a protein-specific chemical stain formulated to enhance latent prints deposited in body fluids rich in proteins, particularly blood. When applied to porous or non-porous surfaces, it chemically binds with dark blue-black intensity to protein matrixes in blood ridges, significantly sharpening friction ridge visibility without destroying underlying DNA evidence.

62. (A) P-3, Q-4, R-1, S-2
Friction skin regions carry specific anatomical names. The thenar pad is positioned at the base of the thumb on the palm. The hypothenar pad spans the ulnar side of the palm beneath the little finger. On the foot sole, the hallucal region lies directly below the big toe, while the calcar region forms the heel.

63. (D) Whorl (Plain)
In the Henry Classification System, standardized upper-case alphabetic symbols represent distinct pattern categories during fingerprint classification and indexing. The capital letter designation "W" represents a Plain Whorl pattern. Other standard primary classification symbols include "U" for ulnar loops, "R" for radial loops, "A" for plain arches, and "T" for tented arches.

64. (B) 8
In the Henry Primary Classification system, numerical values are assigned to finger pairs containing whorls. Fingers 1 and 2 receive 16, fingers 3 and 4 receive 8, fingers 5 and 6 receive 4, fingers 7 and 8 receive 2, and fingers 9 and 10 receive 1. Finger 3 (Right Middle) is thus assigned a value of 8.

65. (B) 1/1
The Henry Primary Classification formula is calculated by dividing (1 + sum of whorl values for even fingers) by (1 + sum of whorl values for odd fingers). Non-whorl patterns such as loops and arches hold a numerical value of zero. Thus, if an individual displays loops across all ten digits, both sums equal zero, yielding 1/1.

66. (D) Alternate Light Source (ALS) optical examination
Forensic analysis follows a non-destructive to destructive testing hierarchy. When analyzing questioned documents for latent fingerprints, investigators employ optical examination using an Alternate Light Source (ALS) first. ALS utilizes variable wavelengths and photoluminescence without applying liquids or chemicals, preserving delicate document inks, paper integrity, and fragile latent ridge residues for subsequent processing.

67. (A) Flexion creases
Flexion creases are permanent skin folds located on palmar, plantar, and digital surfaces corresponding to underlying joint movement areas. Unlike friction ridges, major and minor flexion creases lack dermal papillae and sweat pores. While they remain stable throughout life, forensic experts utilize them primarily as supplementary landmark features during overall pattern examination and comparison.

NODIA

68. (B) Iodine Fuming → Ninhydrin → Silver Nitrate → Physical Developer
Sequential chemical development of porous documents must follow a strict order from least destructive to most destructive. Iodine fuming comes first because it is reversible and non-destructive. Ninhydrin follows to target amino acids. Silver nitrate is used next to detect salt chlorides. Physical Developer is applied last because its wet acidic bath dissolves water-soluble residues.

69. (A) A short ridge connecting two parallel friction ridges.
In fingerprint analysis terminology, individual Level 2 minutiae details define local ridge paths. A crossover, also commonly referred to as a bridge, is a specific minutia formed when a short ridge line spans across an intervening furrow to physically connect two adjacent, parallel friction ridges, forming a connecting cross-bar between them.

70. (D) Items should be wrapped tightly in plastic bags to prevent the prints from rubbing off.
Proper evidence preservation protocol dictates that items carrying latent prints must never

50. (D) Gold and Zinc
Vacuum Metal Deposition is a specialized physical development process conducted inside a thermal vacuum chamber. A micro-layer of gold is thermally evaporated first, distributing uniformly across the substrate except where organic friction ridge oils are deposited. Subsequently, zinc is evaporated, which condenses exclusively onto the gold-coated background areas, creating a sharp negative impression.

51. (A) Photograph the print in situ with a scale.
In forensic crime scene methodology, evidence must be recorded photographically prior to any physical disturbance. Once a latent fingerprint is visualized with powder dusting, it must immediately be photographed in situ using a 1:1 scale macro lens and millimeter ruler before tape lifting is attempted, ensuring permanent visual preservation if lifting fails.

52. (C) Dental stone or Mikrosil casting silicone
Plastic fingerprints are three-dimensional impressions formed in pliable materials like putty, clay, caulk, or wax. To capture and preserve their fine volumetric topography, field investigators apply specialized casting materials such as Mikrosil silicone putty or high-strength dental stone, which flow into fine ridge crevices and cure without causing structural distortion.

53. (A) Automated Fingerprint Identification System
AFIS stands for Automated Fingerprint Identification System. It represents a specialized biometric computer database system utilized by forensic law enforcement agencies to systematically digitize, store, index, search, and cross-compare ten-print reference cards and crime scene latent prints using advanced mathematical algorithms designed for rapid pattern recognition and minutiae feature extraction.

54. (D) The spatial location coordinates and orientation angles of minutiae points.
When an automated system processes a fingerprint image, its algorithms detect and map individual Level 2 minutiae, specifically ridge endings and bifurcations. The software records the precise two-dimensional spatial X-Y coordinates along with the direction vector angle of each minutia point, using these spatial geometric relationships to execute rapid candidate database matches.

55. (B) National Crime Records Bureau (NCRB)
The National Automated Fingerprint Identification System (NAFIS) in India is managed and centrally implemented by the National Crime Records Bureau (NCRB) under the Ministry of Home Affairs. NAFIS provides a web-based central repository storing criminal fingerprint databases accessible across all states and union territories for law enforcement and forensic verification.

56. (C) I and III only
Automated fingerprint identification systems utilize complex algorithms to compare spatial minutiae arrangements, producing a ranked candidate list of probable matching records based on mathematical scores. However, AFIS cannot declare definitive legal identity. A certified human fingerprint examiner must perform side-by-side microscopic evaluations to verify and officially confirm any identification match.

57. (D) Thenar area
The human palmar friction ridge surface is anatomically divided into three major regions for classification and forensic examination: the thenar area, hypothenar area, and interdigital area. The thenar area specifically encompasses the large fleshy prominence positioned at the base of the thumb on the radial side of the human palm.

58. (A) Interdigital area
The interdigital area is the palmar friction ridge region located directly below the metacarpophalangeal joints of the index, middle, ring, and little fingers. It characteristically contains digital deltas positioned beneath each finger base and is sub-classified into four distinct sections during comparative palm print examinations in forensic science casework.

59. (B) Plantar friction ridge skin is unique and permanent, like palmar skin.
Plantar skin covering the soles of human feet develops friction ridge patterns identically to palmar skin on the hands. Formed during prenatal embryonic growth, plantar friction ridges contain unique arrangement details, minutiae, and sweat pores that remain immutable throughout life, making footwear impressions and foot friction ridge prints scientifically reliable for personal identification.

Click Here to Buy book on Flipkart

80. (C) Lift a dusted fingerprint and protectively seal it with attached backing.
A hinge lifter is a specialized crime scene tool composed of a transparent adhesive lifting sheet joined by a flexible hinge to a rigid backing card. After latent prints are developed using fingerprint powder, the adhesive sheet is pressed onto the print, lifted, and folded back onto the attached backing card to protectively seal and preserve the evidence.

81. (B) Plain arch
In fingerprint pattern taxonomy, a plain arch is defined as a pattern where ridges enter from one side of the print, rise smoothly in the center with a gentle wave-like motion, and exit on the opposite side. It is unique among major fingerprint pattern types because it theoretically possesses no core and no delta focal points.

82. (A) I and III
Fingerprint patterns are permanent unless physical trauma damages the underlying dermal papillae, creating permanent scars. As a human body grows from infancy into adulthood, the skin surface expands, causing individual friction ridges and overall pattern dimensions to enlarge physically while maintaining the exact relative spatial arrangement, configuration, and sequence of minutiae points.

83. (A) Parallel to the surface (90-degree angle of view)
Forensic photography of friction ridge impressions requires strict technical adherence to geometric distortion controls. The camera's digital sensor or film plane must be positioned exactly parallel to the substrate surface containing the latent fingerprint, establishing a perpendicular 90-degree focal axis angle. This alignment prevents perspective distortion and parallax error, enabling accurate 1:1 scale documentation.

84. (C) A silver aqueous reagent reacting with lipids and water-insoluble residues.
Physical Developer (PD) is an aqueous analytical reagent containing silver ions, an iron redox system, and a surfactant. Unlike reagents that react with amino acids or salts, PD specifically targets water-insoluble lipid components, such as fats and oils, present in latent deposits on porous surfaces, depositing metallic silver onto ridge impressions to form dark grey or black images.

85. (A) P-2, Q-1, R-4, S-3
Fingerprint pattern classes are defined by structural delta requirements. Plain arches lack type lines, cores, and deltas, requiring zero deltas. Ulnar loops feature a single delta focal point. Plain whorls contain exactly two deltas. Accidental whorls represent complex multi-pattern combinations containing two or more deltas within their unique focal structures.

86. (D) Cyanoacrylate (Superglue)
Ninhydrin, DFO, and Physical Developer are primary chemical reagents formulated specifically for developing latent fingerprints on porous substrates like paper and cardboard. In contrast, cyanoacrylate (Superglue fuming) is used almost exclusively on non-porous and semi-porous surfaces such as glass, metal, hard plastics, and glazed materials to visualize latent ridge residue.

87. (C) Statement I is correct but Statement II is incorrect.
Whorl ridge tracing categorizes whorls into Inner (I), Meeting (M), or Outer (O) types. When tracing from the left delta toward the right delta, if the traced ridge passes inside or above the right delta by three or more ridges, it is classified as an Inner whorl, whereas passing outside or below yields an Outer whorl.

88. (C) A bifurcation with an extremely short branch ending abruptly.
In fingerprint minutiae nomenclature, a spur, also referred to as a hook, is a specific structural variation of a bifurcation. It is defined as a point where a main friction ridge splits into two branches, but one of the newly formed branches terminates abruptly after a very short distance, projecting outward like a spur.

89. (D) Bertillon Anthropometry System
The Henry Classification System, Galton details minutiae terminology, and Vucetich System are recognized frameworks in friction ridge pattern analysis and identification. In contrast, Alphonse Bertillon's anthropometry system (Bertillonage) relied on physical body measurements such as head size and forearm length rather than friction ridge identification, making it unrelated to dactyloscopy classification.

Downloaded from www.pdf.tube

31. (D) Water (approximately 98-99%)
Latent fingerprint residue deposited by palmar surfaces originates primarily from eccrine sweat glands. Human eccrine perspiration is composed overwhelmingly of pure water, accounting for roughly 98 to 99 percent of its total volume. The remaining fraction contains inorganic salts like sodium chloride, alongside organic traces including amino acids, urea, and lactic acid.

32. (C) Touching skin areas rich in sebaceous glands, such as the face, hair, or scalp.
Friction ridge skin on the hands completely lacks sebaceous oil glands. When lipid components like fatty acids, squalene, and triglycerides are identified in latent finger impressions, they originate from secondary transfer. Individuals inadvertently introduce these sebaceous lipids onto their fingers by touching oil-rich anatomical regions such as the face, scalp, or hair.

33. (B) Physical adherence of powder to moisture and oily components of friction ridge residue.
Powder dusting is a physical development method applied to smooth, non-porous surfaces. It operates through mechanical adhesion rather than chemical reaction. Finely milled pigment particles stick physically to the aqueous moisture and lipophilic oil secretions deposited along friction ridges, providing high optical contrast between the developed fingerprint and the underlying substrate.

34. (D) I, II, and III
Magnetic fingerprint powders contain fine iron flakes applied using a Magna brush that lacks physical bristles, preventing mechanical distortion of fragile latent prints. Fluorescent formulations luminesce brilliantly under alternate light sources or ultraviolet light. Traditional black processing powders rely on finely ground carbon black, charcoal, or graphite materials to produce optimal visual contrast.

35. (A) Smooth, non-porous surfaces such as glass, plastic, or coated paper.
Magnetic fingerprint powder consists of finely milled iron particles combined with color pigments. It is applied using a specialized magnetic applicator rod rather than conventional bristle brushes. This technique is exceptionally suited for smooth, non-porous substrates, including polished glass, glossy plastic, ceramics, and coated paper, minimizing physical damage to delicate latent residues.

NODIA

36. (C) Amino acids
Ninhydrin is a standard chemical developer for visualizing latent prints on porous items like paper or cardboard. The chemical specifically targets and reacts with alpha-amino acids and protein residues deposited in eccrine perspiration. This biochemical reaction forms a distinct, highly visible colored complex that reveals the detailed ridge structure under room light.

37. (A) Purple-blue; Ruhemann's purple
When ninhydrin reacts with alpha-amino acids present in latent fingerprint secretions, it undergoes a complex multi-step chemical pathway. The primary reaction product formed is diketohydrindylidene-diketohydrindamine, universally known as Ruhemann's purple. This compound displays an intense purple-blue chromatic color, rendering the latent friction ridge patterns clearly visible on porous evidentiary substrates.

38. (A) P-3, Q-4, R-1, S-2
Different fingerprint reagents target specific chemical compounds. Ninhydrin reacts with amino acids in sweat. Iodine vapor physically absorbs into lipophilic lipids and fatty deposits. Silver nitrate reacts with inorganic sodium chloride ions to yield silver chloride. Physical Developer utilizes aqueous silver solutions to react with water-insoluble lipids present on porous surfaces.

39. (B) They are fugitive and fade quickly unless photographed or fixed.
Iodine fuming relies on sublimation, wherein solid iodine crystals transition directly into gas. The iodine vapors physically absorb into oily, fatty components of latent ridge residue, creating a temporary yellowish-brown print image. Because this physical absorption is fully reversible, developed prints fade quickly as iodine sublimates away, requiring immediate photography or chemical fixing.

40. (C) Starch solution or alpha-naphthoflavone
Because iodine-fumed latent fingerprints fade rapidly through active sublimation, chemical stabilization is required to preserve the developed details permanently. Treating the temporary print with an aqueous starch solution creates

CHAPTER 11

Hair, Fiber, Glass, Paint and Soil Analysis

1. The fundamental principle governing the transfer of trace evidence such as hair, fiber, glass, paint, and soil was formulated by which of the following pioneers of forensic science?
(A) Alphonse Bertillon
(B) Edmond Locard
(C) Francis Galton
(D) Alec Jeffreys

2. Under microscopic examination, human hair typically exhibits which of the following cuticular scale patterns?
(A) Coronal
(B) Spinous
(C) Serrated
(D) Imbricate

3. In the anatomical structure of hair, the pigment granules responsible for hair colour are primarily located in which layer?
(A) Cortex
(B) Cuticle
(C) Medulla
(D) Follicle

4. The medullary index is a crucial parameter used to distinguish between human and animal hair. Which of the following statements represents the standard forensic threshold for this index?
(A) In humans, the medullary index is typically greater than 0.5.
(B) In animals, the medullary index is typically less than 0.3.
(C) In humans, the medullary index is generally 0.33 or less.
(D) In both humans and animals, the index remains constant at 0.5.

5. During the active growth phase, hair is firmly attached to the follicle and exhibits a flame-shaped root bulb when pulled. This phase is known as the:
(A) Anagen phase
(B) Telogen phase
(C) Catagen phase
(D) Exogen phase

6. A hair found at a crime scene has a club-shaped root and was shed naturally without any tearing of the follicular tissue. This hair was in which phase of growth?
(A) Anagen phase
(B) Catagen phase
(C) Progen phase
(D) Telogen phase

7. Forensic examination reveals a hair with a continuous medulla, a thick cuticle, and a circular cross-section. These characteristics are most strongly associated with which of the following racial classifications?
(A) Caucasian
(B) Mongoloid
(C) Negroid
(D) Australoid

8. A forensic scientist is tasked with determining the somatic origin of a hair sample. The hair shows pronounced buckling, a wiry texture, and a continuous to interrupted medulla. It most likely originated from the:
(A) Scalp region
(B) Eyebrow region
(C) Pubic region
(D) Facial beard region

9. Microscopic determination of sex from a pulled hair root relies on the detection of highly condensed chromatin structures known as:
(A) Mitochondria
(B) Ribosomes
(C) Golgi bodies
(D) Barr bodies

10. When attempting to extract DNA from a naturally shed telogen hair without a follicular tag, a forensic scientist should primarily target which type of DNA?
(A) Mitochondrial DNA
(B) Nuclear DNA
(C) Y-chromosomal DNA
(D) Messenger RNA

Click Here to Buy book on Amazon

11. A suspect claims his hair was naturally blonde, but examination under a microscope reveals a sharp demarcation line between the yellow shaft and a dark root. What forensic conclusion can be drawn?
(A) The hair is a synthetic wig fiber.
(B) The hair has been artificially bleached or dyed.
(C) The individual suffers from a nutritional deficiency.
(D) The hair is in the telogen phase.

12. Which of the following best describes the limitations of estimating a person's exact age based solely on microscopic hair examination?
(A) Age can be accurately determined within a 5-year range using advanced microscopic cross-sectional profiling.
(B) Precise age determination is generally not possible, except for distinguishing infant hair from adult hair.
(C) Age can only be reliably determined if the hair is actively growing in the anagen phase with intact roots.
(D) Age can be accurately calculated by measuring the medullary index and shaft diameter under high magnification.

13. Which of the following features is most indicative of an animal hair rather than a human hair?
(A) Medulla occupying more than half of the total shaft diameter
(B) Continuous amorphous medulla with a characteristically narrow width
(C) Flattened imbricate scale pattern distributed along the outer cuticle
(D) Granular pigment concentrated evenly toward the outer cuticle edge

14. What is the recommended standard protocol for collecting control scalp hair samples from a suspect to compare with questioned hair evidence?
(A) Cut 5 to 10 full-length hair strands directly from the front region of the scalp.
(B) Collect 2 to 3 representative hair samples exclusively from the exact crown area.
(C) Pull 50 to 100 full-length hairs from different scalp regions.
(D) Swab the entire scalp surface to collect naturally shed follicular tags and debris.

15. The medullary configuration of human head hair is most commonly observed as:
(A) Continuous ladder-like pattern
(B) Multi-serial vacuolated structure
(C) Continuous lattice configuration
(D) Absent or fragmented pattern

16. Consider the following statements regarding the growth phases of human hair:
I. The anagen phase can last up to six years and is the active growth phase.
II. The catagen phase is a transition stage lasting a few weeks.
III. Nuclear DNA typing is most successful on hair in the telogen phase.
Which of the above statement(s) is/are correct?
(A) II and III only
(B) I and III only
(C) I and II only
(D) I, II, and III

NODIA

17. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): The medullary index is a valuable metric for differentiating between human and animal hair.
Reason (R): In animal hairs, the medulla is generally narrower compared to human hairs.
Select the correct option:
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

18. Match the racial characteristics of hair in List I with their microscopic features in List II:
List I: Racial Characteristics
P. Caucasian
Q. Mongoloid
R. Negroid
S. Animal
List II: Microscopic Features
1. Flattened cross-section, dense uneven pigmentation
2. Oval cross-section, even pigmentation distribution
3. Spinous or coronal scale pattern
4. Round cross-section, dense auburn/black pigment
Select the correct option:
(A) P-1, Q-2, R-4, S-3
(B) P-2, Q-1, R-4, S-3
(C) P-4, Q-2, R-1, S-3

(D) P-2, Q-4, R-1, S-3

19. Fibers are broadly classified into natural and synthetic categories. Which of the following is classified as a regenerated natural fiber?
(A) Rayon
(B) Nylon
(C) Polyester
(D) Acrylic

20. Under a polarizing microscope, a forensic examiner observes a fiber that appears as a flattened, twisted ribbon. This structural feature is characteristic of:
(A) Silk
(B) Wool
(C) Cotton
(D) Linen

21. Which of the following is an animal fiber composed primarily of the protein keratin?
(A) Wool
(B) Silk
(C) Jute
(D) Asbestos

22. In the instrumental analysis of synthetic fibers, which technique is most highly specific for identifying the exact generic class and subclass by analyzing its chemical functional groups?
(A) High-Performance Thin Layer Chromatography (HPTLC)
(B) Flame Atomic Absorption Spectroscopy (FAAS)
(C) Field Emission Scanning Electron Microscopy (FE-SEM)
(D) Fourier Transform Infrared Spectroscopy (FTIR)

23. Birefringence is a key optical property used in fiber examination. It is defined as the:
(A) Ability of a fiber to absorb specific wavelengths of light
(B) Difference between the two refractive indices of a fiber
(C) Ratio of the speed of light in a vacuum to that in the fiber
(D) Point at which the Becke line disappears

24. Delustering agents are often added to synthetic fibers to reduce shine. What is the most common chemical compound used for this purpose, visible as dark specks under a microscope?
(A) Calcium carbonate
(B) Silicon dioxide
(C) Titanium dioxide
(D) Lead oxide

25. Which instrumental technique involves heating a fiber until it decomposes into volatile products, which are then separated and identified to produce a highly specific chemical fingerprint?
(A) Microspectrophotometry
(B) X-ray Diffraction (XRD)
(C) Liquid Chromatography-Mass Spectrometry (LC-MS)
(D) Pyrolysis Gas Chromatography (Py-GC)

26. In forensic fiber analysis, the physical matching of a torn piece of fabric left at a crime scene to a suspect's garment is considered:
(A) Individual evidence
(B) Class evidence
(C) Circumstantial evidence
(D) Trace evidence with low probative value

27. To analyze and compare the dye components of trace fibers without fully destroying the polymeric structure, the most common preliminary extraction and separation technique used is:
(A) Gas Chromatography (GC)
(B) Thin Layer Chromatography (TLC)
(C) Neutron Activation Analysis (NAA)
(D) Inductively Coupled Plasma Mass Spectrometry (ICP-MS)

28. Which cross-sectional shape is highly indicative of synthetic carpet fibers, manufactured specifically to scatter light and hide soil?
(A) Circular
(B) Trilobal
(C) Dog-bone
(D) Flattened ribbon

29. A victim is grabbed by an assailant, and fibers from the assailant's sweater are directly transferred to the victim's shirt. This is technically termed:
(A) Primary transfer
(B) Secondary transfer
(C) Tertiary transfer
(D) Cross-contamination transfer

30. Which of the following optical instruments allows a forensic examiner to simultaneously view a questioned fiber and a known fiber side-by-side in the same visual field?
(A) Stereomicroscope
(B) Polarizing microscope

Downloaded from www.pdf.tube

(C) Comparison microscope
(D) Phase-contrast microscope

31. Consider the following statements regarding fiber analysis:
I. Silk is a continuous filament extruded by the silkworm and lacks a scale structure.
II. Synthetics like nylon exhibit high birefringence under polarized light.
III. Microspectrophotometry is used to destructively analyze fiber dyes.
IV. Cross-sectional shape is an important class characteristic for synthetic fibers.
Which of the above statement(s) is/are correct?
(A) I, II, and III only
(B) II, III, and IV only
(C) I, III, and IV only
(D) I, II, and IV only

32. Match the fiber categories in List I with their appropriate examples in List II:
List I: Fiber Categories
P. Natural Plant Fiber
Q. Natural Animal Fiber
R. Regenerated Fiber
S. Synthetic Fiber
List II: Examples
1. Acetate
2. Jute
3. Acrylic
4. Cashmere
Select the correct option:
(A) P-2, Q-4, R-3, S-1
(B) P-4, Q-2, R-1, S-3
(C) P-2, Q-4, R-1, S-3
(D) P-1, Q-4, R-2, S-3

33. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Natural fibers such as cotton and wool generally show highly uniform cross-sectional shapes and diameters compared to synthetic fibers.
Reason (R): Synthetic fibers are manufactured by extruding polymers through a spinneret, ensuring precise control over their physical dimensions.
Select the correct option:
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

34. All of the following are examples of natural fibers of plant origin EXCEPT:
(A) Coir
(B) Hemp
(C) Sisal
(D) Asbestos

35. Select the correct sequence of steps typically followed in the forensic examination of unknown fiber evidence:
(A) Microscopic examination → Polarized light analysis → Microspectrophotometry → Destructive chemical testing
(B) Destructive chemical testing → Microscopic examination → Dye extraction → Polarized light analysis
(C) Dye extraction → Microscopic examination → Destructive chemical testing → Polarized light analysis
(D) Polarized light analysis → Destructive chemical testing → Dye extraction → Microscopic examination

NODIA

36. Find the odd one out among the following properties used to classify and compare fibers:
(A) Refractive index
(B) Birefringence
(C) Medullary index
(D) Cross-sectional shape

37. The primary chemical component forming the backbone of ordinary commercial glass is:
(A) Silicon dioxide
(B) Calcium carbonate
(C) Sodium carbonate
(D) Boron oxide

38. When window glass is manufactured, sodium carbonate (soda) is added to the sand. What is the primary purpose of this additive?
(A) To significantly increase the tensile hardness and structural strength of the glass
(B) To render the glass completely insoluble and resistant to water degradation
(C) To impart a distinct specific tint or colour throughout the glass matrix
(D) To lower the melting point and viscosity of the silica sand

39. A car windshield is designed to fracture into small, relatively harmless blunt pieces rather than sharp shards. This property is achieved by using:

(A) Tempered glass
(B) Laminated glass
(C) Borosilicate glass
(D) Lead glass

40. In standard automotive construction, the side and rear windows are typically made of:
(A) Laminated glass
(B) Soda-lime sheet glass
(C) Tempered glass
(D) Borosilicate glass

41. Glass is best described physically as a:
(A) Rigid three-dimensional crystalline solid
(B) Synthetic polymeric composite material
(C) Homogeneous non-magnetic metallic alloy
(D) Supercooled liquid or amorphous solid

42. The refractive index (RI) of a glass fragment is a critical physical property. It is mathematically defined as the ratio of the:
(A) Speed of light in vacuum to speed of light in glass
(B) Ratio of the bulk density of the glass to the reference density of pure water
(C) Ratio of the total mass of the glass sample to its displacement volume
(D) Ratio of the sine of the angle of incidence to the angle of reflection

43. In the immersion method for measuring the refractive index of glass, what optical phenomenon is observed to determine when the RI of the glass matches the RI of the liquid?
(A) Birefringent double refraction interference
(B) Disappearance of the Becke line
(C) Appearance of concentric Newton's interference rings
(D) Phenomenon of complete total internal reflection

44. During Becke line analysis, when the microscope objective is raised, the bright halo (Becke line) moves toward the glass fragment. This indicates that:
(A) The glass has a lower refractive index than the surrounding immersion liquid.
(B) The glass has a higher refractive index than the immersion liquid.
(C) The glass and the immersion liquid possess the exact same refractive index.
(D) The glass fragment is composed entirely of toughened tempered glass.

45. The GRIM (Glass Refractive Index Measurement) system automates RI determination by:
(A) Varying oil temperature while monitoring Becke line contrast
(B) Precise measurement of the deflection angle during automated laser refraction
(C) Continuous measurement of particle density variations within a flotation tube
(D) Bombarding the glass specimen with monochromatic X-rays to obtain an elemental profile

46. The density of a tiny glass fragment is typically measured in a forensic laboratory using which technique?
(A) Traditional Archimedes' volumetric water displacement method
(B) Weighing on an analytical microbalance and calculating volume geometrically
(C) Flotation method using bromoform and bromobenzene
(D) Pyrolysis gas chromatography-mass spectrometry analysis

47. When a projectile impacts a pane of glass, it produces fracture lines. The cracks that radiate outward from the point of impact like the spokes of a wheel are called:
(A) Concentric cracks
(B) Conchoidal cracks
(C) Stress marks
(D) Radial cracks

48. According to the 3R Rule used in glass fracture analysis, Radial cracks form a Right angle on the:
(A) Front surface of the glass
(B) Same side as the force
(C) Reverse side of the force
(D) Concentric edge of the break

49. By examining the crater-like hole produced by a high-velocity projectile passing through a glass pane, a forensic examiner can determine the direction of impact because the hole is typically:
(A) Wider on the entrance side
(B) Wider on the exit side
(C) Symmetrical on both sides
(D) Melted smoothly along the edges

50. Two bullet holes are present in a glass window. The radial fractures from Hole B terminate at the radial fractures from Hole A. What can be concluded?

Click Here to Buy book on Flipkart

84. Consider the following components relevant to soil examination:
I. Mineral content
II. Pollen and spores
III. Microscopic debris like brick dust or paint flakes
Which of the above can contribute to the forensic comparison and origin-tracing of a questioned soil sample?
(A) I and II only
(B) I and III only
(C) I, II, and III
(D) II and III only

85. A body is found in an area characterized by alluvial soil, but mud on the tires of a suspect's vehicle contains high concentrations of red laterite soil and distinct regional pollen. Forensic analysis suggests:
(A) Vehicle was recently in a different geographic region.
(B) The victim was unequivocally murdered at the immediate primary crime scene location
(C) The mud adhering to the tire treads underwent rapid local chemical weathering
(D) The deceased victim was forcibly dragged across the surrounding alluvial soil bed

86. Consider the following statements regarding palynological analysis:
I. Spores are primarily produced by flowering plants (angiosperms).
II. Anemophilous (wind-pollinated) plants produce vast quantities of lightweight pollen.
III. Entomophilous (insect-pollinated) plants produce sticky pollen that rarely travels far from the plant.
IV. Pollen evidence can help estimate the season when a crime occurred.
Which of the above statement(s) is/are correct?
(A) I, II, and III only
(B) I, III, and IV only
(C) I, II, and IV only
(D) II, III, and IV only

87. An investigator finds a lump of soil adhered to a suspect's shoe. When packaging this evidence for forensic analysis, the best practice is to:
(A) Carefully scrape the soil into a glass vial and wash the shoe.
(B) Wrap the entire shoe in paper without removing the soil.
(C) Place the shoe in a sealed airtight plastic container to retain moisture.
(D) Brush the soil off entirely to collect the surface dust.

88. Arrange the standard steps of forensic soil examination in the correct procedural sequence:
I. Mineralogical identification using a polarizing microscope
II. Macroscopic visual comparison of dry soil colour
III. Density gradient tube comparison
IV. Sieving to evaluate particle size distribution (texture)
Select the correct sequence:
(A) IV, II, I, III
(B) II, III, IV, I
(C) II, IV, III, I
(D) III, I, II, IV

89. Find the odd one out from the following analytical techniques concerning their primary use in tracing soil origin:
(A) Evaluation of Munsell colour
(B) Analyzing particle size distribution
(C) Identifying specific pollen grains
(D) Counting ridges and bifurcations

90. Which of the following attributes makes soil highly valuable as trace evidence under Locard's Exchange Principle?
(A) Transfers easily on contact and offers strong local class evidence.
(B) Soil is completely biologically sterile and remains immune to organic degradation over time
(C) Soil deposits routinely provide a unique physical fracture match to original ground strata
(D) Soil maintains an identical mineral composition universally across an entire state region

NODIA
www.nodia.in

matches the suspect's headlamp assembly.

57. Automotive paint is a highly complex mixture. Which fundamental component is the polymeric substance that provides the support medium for the pigments and adheres to the vehicle surface?
(A) Volatile solvent
(B) Synthetic plasticizer
(C) Inorganic extender
(D) Binder (Resin)

58. Modern automobile manufacturing uses a multi-layered painting process. Which layer is directly applied to the steel body of the vehicle to provide superior corrosion resistance?
(A) Electrocoat primer
(B) Protective clearcoat
(C) Intermediate primer surfacer
(D) Pigmented basecoat

59. In the context of automotive paint, which layer imparts the actual colour and aesthetic finish of the vehicle?
(A) Electrocoat primer
(B) Basecoat
(C) Primer surfacer
(D) Clearcoat

60. The unpigmented final layer applied to modern automobiles to improve gloss, durability, and provide UV resistance is called the:
(A) Sealant layer
(B) Clearcoat layer
(C) Primer surfacer layer
(D) Pigmented basecoat layer

61. Under a stereomicroscope, the most important class characteristic that a forensic scientist evaluates when comparing questioned and known paint chips is:
(A) Layer colour sequence and thickness
(B) Exact chemical formulation of inorganic pigments
(C) Refractive index measurements of the clearcoat
(D) Volatile solvent composition within the resin matrix

62. Which analytical instrument provides an absorption spectrum that serves as a unique "fingerprint" identifying the chemical formulation of a paint binder?
(A) Scanning Electron Microscope (SEM)
(B) Atomic Absorption Spectrometer
(C) Fourier Transform Infrared Spectrometer (FTIR)
(D) Gas Chromatography with Flame Ionization Detector

63. To analyze the inorganic elemental composition of paint pigments, which instrumental pairing is most frequently employed in forensic laboratories?
(A) Pyrolysis Gas Chromatography coupled with Mass Spectrometry (Py-GC-MS)
(B) High-Performance Liquid Chromatography with Photodiode Array (HPLC-PDA)
(C) Ultraviolet-Visible Double-Beam Spectrophotometry (UV-Vis)
(D) SEM-EDX elemental spectroscopy

64. Forensic laboratories frequently use a computerized database to identify the make, model, and year of a vehicle based on the chemical composition of original automotive paint. This database is known as:
(A) CODIS (Combined DNA Index System)
(B) NIBIN (National Integrated Ballistic Information Network)
(C) PDQ (Paint Data Query)
(D) AFIS (Automated Fingerprint Identification System)

65. Architectural (house) paints generally differ from automotive paints primarily because architectural paints:
(A) Completely lack organic binders, synthetic resins, and drying additives
(B) Lack complex electrocoat and clearcoat layer structures.
(C) Are formulated entirely from coarse inorganic mineral pigments and fillers
(D) Utilize water-based media that eliminate the need for organic drying solvents

66. Consider the following statements regarding paint evidence:
I. Paint chips can sometimes be physically matched to a suspect vehicle like pieces of a jigsaw puzzle.
II. Pyrolysis Gas Chromatography can distinguish between similar paint binders by breaking them down into gaseous products.
III. The clearcoat layer contains the highest concentration of metallic pigments.
IV. Paint smears on a victim's clothing from a hit-and-run are usually evaluated using FTIR and SEM-EDX.
Which of the above statement(s) is/are correct?

NODIA

(A) Hole B was created before Hole A.
(B) Both holes were created simultaneously.
(C) No conclusion regarding the sequence can be drawn.
(D) Hole A was created before Hole B.

51. Elemental analysis of glass can trace minor and trace elements to individualize a sample. Which advanced instrumental technique is highly sensitive and frequently used for this purpose?
(A) Inductively Coupled Plasma Mass Spectrometry (ICP-MS)
(B) High-Performance Thin Layer Chromatography with Fluorescence Detection (HPTLC)
(C) UV-Visible-NIR Microspectrophotometry with Polarizing Optics
(D) Ultra High Performance Liquid Chromatography with Photodiode Array Detection (UPLC-PDA)

52. Consider the following statements about glass fractures:
I. Radial cracks form first, starting on the side opposite the destructive force.
II. Concentric cracks form afterward, starting on the same side as the destructive force.
III. Tempered glass fractures into characteristic long, sharp splinters.
Which of the above statement(s) is/are correct?
(A) II and III only
(B) I and III only
(C) I and II only
(D) I, II, and III

53. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): The physical fitting together of broken glass fragments like a jigsaw puzzle provides individual characteristics linking the pieces to a common source.
Reason (R): Glass is an amorphous solid, and cracks propagate randomly, ensuring that no two break patterns are ever identical.
Select the correct option:
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

54. Match the type of glass in List I with its defining characteristic or use in List II:
List I: Type of Glass
P. Borosilicate glass
Q. Tempered glass
R. Laminated glass
S. Soda-lime glass
List II: Defining Characteristic or Use
1. Two sheets of glass bonded with a plastic interlayer
2. Rapidly cooled to induce surface compression stresses
3. Contains boron oxide for thermal resistance
4. Standard composition for ordinary window panes
Select the correct option:
(A) P-3, Q-1, R-2, S-4
(B) P-4, Q-2, R-1, S-3
(C) P-2, Q-3, R-4, S-1
(D) P-3, Q-2, R-1, S-4

55. Arrange the operational steps of determining a glass fragment's refractive index using the GRIM method in the correct sequence:
I. The matching temperature is recorded electronically.
II. The glass fragment is immersed in a specialized silicone oil.
III. The temperature of the oil is gradually altered to change its refractive index.
IV. The contrast of the glass edge (Becke line) is monitored by a video system until it disappears.
Select the correct order:
(A) II, IV, III, I
(B) II, III, IV, I
(C) III, II, IV, I
(D) IV, II, III, I

56. A hit-and-run collision occurs, and small glass fragments are recovered from the victim's clothing. Which of the following parameters alone would definitively establish that the glass fragments originated exclusively from the suspect's vehicle headlamp?
(A) The glass fragments share an identical refractive index with the suspect's headlamp assembly.
(B) The glass fragments possess the exact same physical density as the suspect's headlamp assembly.
(C) A physical fracture match fits the fragments to the headlamp assembly.
(D) The trace elemental profile of the fragments

Downloaded from www.pdf.tube

artificial. The decomposed organic matter in soil is called:
(A) Humus
(B) Silicate
(C) Loam
(D) Quartz

75. The initial forensic examination of soil samples typically involves comparing their colour. To ensure standardization, soil colour is compared when the samples are dry and evaluated against a reference standard known as the:
(A) Pantone Matching System
(B) Munsell Soil Color Chart
(C) Becke Line Standard
(D) Locard Soil Index

76. In forensic soil analysis, the separation of soil particles by size (texture) to establish a distribution profile is most commonly achieved using:
(A) Paper and thin-layer chromatography methods
(B) Nested standard sieves
(C) High-resolution density gradient tube settling
(D) High-speed differential centrifugation techniques

77. The density gradient tube technique is used to compare the densities of soil particles. What two liquids are typically mixed in varying proportions to create the density gradient?
(A) Bromoform and bromobenzene
(B) Distilled water and absolute ethanol
(C) Purified chloroform and absolute methanol
(D) Technical-grade hexane and pure acetone

78. Consider the following statements regarding the density gradient tube technique in soil examination:
I. Soil particles added to the tube will sink until they reach a liquid layer of equal density.
II. Identical soil samples will produce the exact same distribution band pattern.
III. The technique is definitive enough to individualize a soil sample to a single specific location in the world.
Which of the above statement(s) is/are correct?
(A) II and III only
(B) I and III only
(C) I and II only
(D) I, II, and III

79. The mineralogical analysis of soil involves identifying naturally occurring crystals characterized by specific physical properties. This is typically accomplished using a:
(A) Scanning Electron Microscope
(B) Gas Chromatograph
(C) Spectrophotometer
(D) Polarizing Light Microscope

80. The branch of forensic science that involves the collection and examination of pollen and spores connected with crime scenes, illegal activities, or terrorism is known as:
(A) Forensic Entomology
(B) Forensic Anthropology
(C) Forensic Palynology
(D) Forensic Odontology

81. In forensic palynology, the highly durable outer layer of a pollen grain, which resists degradation and preserves species-specific morphology, is called the:
(A) Intine
(B) Exine
(C) Cuticle
(D) Cortex

82. Which of the following protocols is correct for collecting soil evidence from a crime scene and suspect?
(A) Soil should only be collected from the exact centre of the crime scene.
(B) Wet soil samples found on a suspect's shoes must be scraped off immediately and sealed in airtight plastic bags to prevent drying.
(C) Soil samples should be chemically sterilized prior to packaging.
(D) Alibi soil samples should be collected from various locations claimed by the suspect to rule out innocent transfer.

NODIA

83. The evidentiary value of soil is primarily based on which forensic concept?
(A) High local composition variability providing associative links.
(B) The exact global chemical replication and structural uniformity of all natural minerals
(C) The ability to routinely extract nuclear DNA directly from pure crystalline silicon dioxide
(D) The broad structural uniformity of soil profiles across expansive geographic region spans

(A) I, II, and III only
(B) II, III, and IV only
(C) I, III, and IV only
(D) I, II, and IV only

67. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Microscopic matching of the layer sequence of a multi-layered paint chip provides strong associative evidence linking it to a specific source vehicle.
Reason (R): Successive application of aftermarket repainting dramatically increases the uniqueness of the paint chip's layer sequence.
Select the correct option:
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

68. Select the correct sequence of paint layers as applied by original equipment manufacturers (OEM) to the sheet steel of a vehicle, from innermost to outermost:
(A) Primer surfacer → Electrocoat primer → Clearcoat → Basecoat
(B) Basecoat → Electrocoat primer → Primer surfacer → Clearcoat
(C) Electrocoat primer → Primer surfacer → Basecoat → Clearcoat
(D) Electrocoat primer → Basecoat → Primer surfacer → Clearcoat

69. When collecting paint evidence from a vehicle involved in a hit-and-run, the forensic investigator must ensure they collect an "uncontaminated" standard reference sample. Where should this sample be taken from?
(A) From an undamaged area adjacent to the impact site.
(B) Directly from the heavily fractured center of the impact damage site
(C) From the surrounding road surface near where the vehicle was recovered
(D) By scraping the entire damaged door panel down to bare underlying metal

70. When a paint transfer smear is found on an injured pedestrian's clothing without distinct layer structure, the forensic approach generally shifts from microscopic layer comparison to:
(A) Detailed physical fracture matching of microscopic smear edges and contours
(B) Attempting nuclear DNA extraction and profiling from residual paint binders
(C) Measuring the precise refractive index of microscopic clearcoat particles
(D) Chemical composition profiling via FTIR and SEM-EDX.

71. All of the following are standard instrumental techniques for analyzing paint evidence EXCEPT:
(A) Pyrolysis Gas Chromatography
(B) DNA Microarray Analysis
(C) Fourier Transform Infrared Spectroscopy
(D) Scanning Electron Microscopy

72. Match the forensic paint analysis technique in List I with its specific analytical target in List II:
List I: Forensic Paint Analysis Technique
P. Stereomicroscopy
Q. Pyrolysis Gas Chromatography
R. SEM-EDX
S. Fourier Transform Infrared Spectroscopy (FTIR)
List II: Specific Analytical Target
1. Chemical identification of the organic binder based on infrared absorption
2. Elemental composition of inorganic pigments
3. Thermal decomposition profile of the organic binder
4. Evaluation of layer colour, sequence, and thickness
Select the correct option:
(A) P-4, Q-1, R-2, S-3
(B) P-2, Q-3, R-4, S-1
(C) P-4, Q-3, R-2, S-1
(D) P-3, Q-4, R-1, S-2

73. Which of the following functions is primarily associated with the 'primer surfacer' layer in automotive paint systems?
(A) Providing the primary vehicle colour
(B) Acting as a sacrificial layer against ultraviolet degradation
(C) Binding directly to the bare metal through electrodeposition
(D) Smoothing out seams and imperfections before colour application

74. Soil is a complex natural mixture. In forensic science, soil is broadly defined to include disintegrated surface material, both natural and

Click Here to Buy book on Amazon

ANSWERS

1. (B) Edmond Locard
Edmond Locard formulated the exchange principle, a foundational concept in forensic science. It dictates that whenever two objects come into contact with one another, a mutual transfer of material occurs. Consequently, perpetrators leave trace evidence such as hair, fibers, glass, paint, or soil at crime scenes while simultaneously bearing trace materials away on their person.

2. (D) Imbricate
The outer layer of human hair consists of overlapping scales known as the cuticle. Human hair characteristically features an imbricate scale pattern, which consists of flattened, overlapping scales with narrow margins. In contrast, coronal scales resembling overlapping cups and spinous scales with triangular projections are found exclusively in non-human animal species, aiding in species identification.

3. (A) Cortex
The cortex forms the main body of the hair shaft and lies between the cuticle and the medulla. Composed of elongated, spindle-shaped cortical cells aligned parallel to the length of the hair, it contains the pigment granules that determine natural hair color. Examination of cortex color, size, and pigment distribution is critical for forensic hair comparison.

4. (C) In humans, the medullary index is generally 0.33 or less.
The medullary index measures the ratio of the medulla diameter to the total hair shaft diameter. Human hair typically exhibits a medullary index of one-third or less, reflecting a relatively thin central core. Conversely, animal hairs generally feature a significantly wider medulla, yielding a medullary index value of one-half or greater, enabling clear forensic species differentiation.

5. (A) Anagen phase
Hair growth progresses through three distinct phases: anagen, catagen, and telogen. The anagen phase represents the active growth period, lasting up to six years. Hair pulled forcibly during anagen retains a flame-shaped root bulb and attached follicular tissue rich in nuclear material, rendering it exceptionally valuable for forensic nuclear deoxyribonucleic acid testing and personal identification.

6. (D) Telogen phase
The telogen phase is the final, resting stage of the hair growth cycle. During this period, cellular growth ceases entirely, and the root takes on a club-shaped appearance. Naturally shed hairs entering this phase push out of the follicle without adhering tissue or tearing surrounding skin structures, making them typical findings on clothing, bedding, and scene surfaces.

7. (B) Mongoloid
Microscopic examination of hair provides key details regarding geographic and ancestral origins. Hairs originating from Mongoloid ancestral groups typically exhibit a circular cross-section, a straight shaft, a thick outer cuticle, and dense, evenly distributed pigment granules. Additionally, these hair fibers frequently feature a prominent continuous medulla, distinguishing them from Caucasian and Negroid hairs.

8. (C) Pubic region
Somatic origin determination involves assessing structural variation across body regions. Pubic hairs demonstrate distinct physical characteristics, including coarse texture, marked shaft diameter variations, and pronounced buckling along their length. They routinely feature an interrupted or continuous medulla and blunt or abraded tips, differentiating them from circular scalp hairs, tapered facial beard hairs, and thin eyebrow strands.

9. (D) Barr bodies
Sex determination from hair tissue relies on analyzing nucleated cells preserved within intact root sheaths or attached follicular tags. Barr bodies represent inactivated, highly condensed X chromosomes present at the periphery of cell nuclei in biological females. Identifying these condensed chromatin structures under a microscope provides microscopic evidence of female origin when intact cellular material is retrieved.

NODIA

81. (B) Exine
Pollen grains possess an extraordinarily durable outer shell known as the exine, composed primarily of sporopollenin, one of the most chemically resistant biological polymers known. The exine resists chemical decay, environmental weathering, microbial decomposition, and strong acids. Furthermore, its surface displays complex, species-specific microscopic sculpture patterns, enabling definitive botanical identification of pollen preserved in forensic soil samples.

82. (D) Alibi soil samples should be collected from various locations claimed by the suspect to rule out innocent transfer.
Proper forensic soil collection requires gathering reference standards from the crime scene, surrounding areas, and alibi locations cited by a suspect. Collecting alibi soil standards allows forensic scientists to test and potentially rule out claims of innocent transfer. Wet soil evidence should be air-dried before packaging in breathable paper containers to prevent microbial decay and mould growth.

83. (A) High local composition variability providing associative links.
Soil possesses exceptional forensic value due to its high degree of localized composition variability. Physical, chemical, biological, and mineralogical characteristics of surface soil change significantly over short geographical distances. This localized variability allows forensic examiners to evaluate whether questioned soil recovered from a suspect's footwear or vehicle matches control soil from a specific crime scene location, establishing associative evidence.

84. (C) I, II, and III
Forensic soil comparison relies on evaluating all natural and artificial components present within a matrix. Mineral content establishes geological origin, while botanical materials like pollen and spores provide localized environmental signatures. Additionally, artificial micro-debris such as glass fragments, brick dust, or paint flakes enhances evidence individuality, providing powerful associative links between questioned samples and specific geographical sites.

85. (A) Vehicle was recently in a different geographic region.
Finding soil on a suspect's vehicle tires that differs markedly in color, mineral composition, and pollen profile from local crime scene soil indicates geographical displacement. The presence of distinct red laterite soil and foreign plant pollen proves that the vehicle traveled through a different geographic region where those specific soil types and botanical species exist, refuting local exclusivity.

86. (D) II, III, and IV only
Plant reproduction mechanisms govern pollen dispersal characteristics in forensic investigations. Spores are produced by non-flowering plants like ferns and mosses, whereas pollen originates from seed plants. Wind-pollinated plants release vast quantities of lightweight pollen dispersing over wide areas. Insect-pollinated plants produce sticky pollen that remains localized. Additionally, seasonal flowering cycles allow pollen profiles to estimate the timing of criminal activities.

87. (B) Wrap the entire shoe in paper without removing the soil.
When evidence like footwear bears adhered soil, field investigators should avoid scraping or removing soil deposits at the scene. Dislodging dried soil destroys spatial layering that might reveal sequential contact history. The correct collection protocol requires wrapping the entire shoe in breathable paper, securing it carefully to preserve intact soil masses and prevent loss of trace evidence during transport.

88. (C) II, IV, III, I
Forensic soil analysis follows a systematic analytical sequence from non-destructive visual checks to detailed microscopic examinations. First, macroscopic visual comparison of dry soil color is performed using color charts. Next, particle size distribution is determined through sieving. Density gradient tube comparison is then conducted to evaluate mass distribution patterns. Finally, microscopic mineral identification using a polarizing light microscope is completed.

89. (D) Counting ridges and bifurcations
Soil analysis techniques focus on geological, physical, and biological parameters that establish origin and sample comparability. Evaluating Munsell color codes, analyzing particle size distribution through sieving, and identifying plant pollen grains represent standard forensic procedures for characterizing soil samples. In contrast, counting friction ridges and bifurcations is a pattern recognition technique

Downloaded from www.pdf.tube

polymers, primarily cellulose derived from wood pulp or cotton linters. Rayon was the first commercially produced regenerated fiber, created by dissolving cellulose and extruding it through spinnerets into filaments. In contrast, synthetic fibers like nylon, polyester, and acrylic are synthesized entirely from petrochemical building blocks through chemical polymerization.

20. (C) Cotton
Cotton is a natural seed fiber composed almost entirely of cellulose. When observed under optical magnification or polarizing microscopy, cotton fibers exhibit a unique morphological structure resembling a flattened, twisted ribbon with frequent reversals in twist direction. These characteristic structural convolutions distinguish cotton from other natural plant fibers such as linen and jute, as well as smooth synthetic filaments.

21. (A) Wool
Wool is a natural protein fiber obtained from the fleece of sheep and other animals. Like human hair, wool fibers are primarily composed of the structural protein keratin. Microscopic examination of wool reveals characteristic overlapping cuticular scales and variable medulla structures. In contrast, silk is composed of fibroid protein, while plant fibers consist of cellulose and minerals.

22. (D) Fourier Transform Infrared Spectroscopy (FTIR)
Fourier Transform Infrared Spectroscopy coupled with microscopy is the definitive technique for non-destructive chemical identification of synthetic fibers. By measuring infrared absorption corresponding to molecular bond vibrations, FTIR generates a characteristic spectrum that identifies specific polymeric functional groups. This allows precise determination of the fiber's generic class, such as acrylic, polyester, or polyamide, along with specific polymer subclasses.

23. (B) Difference between the two refractive indices of a fiber
Synthetic and natural fibers often exhibit anisotropic optical properties due to aligned molecular polymer chains. Birefringence is defined as the numerical difference between the refractive index parallel to the fiber axis and the refractive index perpendicular to the axis. Measured using polarized light microscopy, birefringence provides a crucial quantitative parameter for identifying and comparing synthetic fiber types.

NODIA

24. (C) Titanium dioxide
During the manufacturing of synthetic fibers, delustering agents are introduced into the polymer melt to reduce unnatural sheen and transparency. Titanium dioxide is the primary chemical compound utilized for this purpose. Under microscopic examination, these inorganic titanium dioxide particles appear as fine, dark, uniformly dispersed specks along the fiber shaft, serving as a useful class characteristic for comparative analysis.

25. (D) Pyrolysis Gas Chromatography (Py-GC)
Pyrolysis gas chromatography involves thermally decomposing non-volatile polymeric fiber samples in an inert atmosphere using high temperatures. The resulting volatile degradation products are swept into a gas chromatograph, where they are separated and detected. This generates a detailed pyrogram representing a specific chemical fingerprint of the polymer composition, distinguishing subtle formulation differences among synthetic fiber classes.

26. (A) Individual evidence
Trace fibers typically represent class evidence because mass production yields identical garments. However, when a torn piece of fabric left at a crime scene can be physically fitted back into a damaged garment worn by a suspect, a fracture match is established. Physical matching provides individual evidence, conclusively demonstrating that the fabric fragment originated from that specific garment.

27. (B) Thin Layer Chromatography (TLC)
Thin layer chromatography is a standard preliminary method used in forensic laboratories to analyze and compare dye components extracted from trace fibers. After extracting the dye using appropriate chemical solvents, minute liquid amounts are spotted onto a TLC plate and developed. Separation of individual pigment components produces distinct chromatic patterns, allowing precise comparison between questioned and known fiber dyes.

pigment compounds across individual paint layers.

64. (C) PDQ (Paint Data Query)
Paint Data Query is an international computerized database maintained by forensic law enforcement agencies, including the Royal Canadian Mounted Police. PDQ contains detailed information on chemical formulations, layer structures, and organic binder compositions of original automotive factory paints. By analyzing paint chips recovered from hit-and-run scenes, examiners query PDQ to identify the make, model, and manufacturing year of suspect vehicles.

65. (B) Lack complex electrocoat and clearcoat layer structures.
Architectural paints applied to residential buildings differ structurally from modern automotive finishing systems. While automotive finishes feature complex multi-layer structures, including electrocoat primers, primer surfacers, metallic basecoats, and clearcoats, architectural paints typically consist of simpler single or double coat applications. Consequently, architectural paint comparisons focus heavily on binder resin identification and pigment element distribution across historical repainting layers.

66. (D) I, II, and IV only
Paint chips can produce definitive individual evidence through physical fracture matching. Pyrolysis gas chromatography effectively distinguishes binder resins by analyzing thermal decomposition gases. Paint transfer smears lacking defined layer structures are routinely characterized using FTIR and SEM-EDX. Metallic pigments are concentrated within colored basecoats rather than clearcoats, which are formulated completely unpigmented to maintain maximum visual clarity.

67. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Microscopic comparison of paint layer sequences provides powerful associative evidence between crime scene samples and suspect vehicles. Factory paint finishes follow standardized layer sequences. However, when vehicles undergo aftermarket repainting, unique combinations of paint colors, thicknesses, and formulations are added. This custom layer sequence significantly increases overall individuality, making source attribution far more conclusive during comparative forensic analysis.

68. (C) Electrocoat primer → Primer surfacer → Basecoat → Clearcoat
Original equipment manufacturers follow a strict sequential application process for vehicle coatings. First, the bare steel body receives an electrocoat primer for corrosion prevention. Next, a primer surfacer is applied to smooth surface imperfections and enhance adhesion. This is followed by the pigmented basecoat providing color. Finally, an unpigmented clearcoat is applied as the top protective layer.

69. (A) From an undamaged area adjacent to the impact site.
Standard reference paint samples must represent the original intact paint layer structure of a suspect vehicle without contamination. Forensic investigators collect control paint standard samples from an undamaged area immediately adjacent to the impact site. Scraped down to bare metal, this control sample provides a clean reference showing the full layer sequence for comparison against questioned paint fragments.

70. (D) Chemical composition profiling via FTIR and SEM-EDX.
Paint evidence transferred as thin smears onto pedestrian garments during vehicular impacts often lacks discrete physical layer structure. Because physical fracture matching and layer sequence comparison are impossible on disorganized smears, forensic examination shifts to chemical composition profiling. Utilizing micro-FTIR and SEM-EDX allows examiners to determine binder resin identity and inorganic pigment elements, providing reliable comparative class evidence.

71. (B) DNA Microarray Analysis
Paint is an inorganic and synthetic organic material composed of polymers, pigments, extenders, and additives containing no biological material or cellular structures. Standard analytical techniques for paint evidence include Fourier Transform Infrared Spectroscopy, Pyrolysis Gas Chromatography, and Scanning Electron Microscopy. DNA microarray analysis evaluates biological genetic material and has no application in analyzing non-biological paint samples.

Click Here to Buy book on Flipkart

diameter, a biological metric used exclusively in hair examination rather than fiber analysis.

37. (A) Silicon dioxide
Commercial glass is an inorganic fused mixture composed primarily of silicon dioxide, commonly known as silica sand. Silica forms the fundamental structural network matrix of glass. To facilitate manufacturing, additional chemical compounds like sodium carbonate and calcium oxide are added to lower melting temperatures and provide chemical durability, forming the standard soda-lime-silica composition used in everyday products.

38. (D) To lower the melting point and viscosity of the silica sand
Pure silicon dioxide requires extremely high temperatures exceeding seventeen hundred degrees Celsius to melt, making glass production energy-intensive. Adding sodium carbonate, commonly known as soda, lowers the melting temperature and decreases the viscosity of the molten silica mix. This significantly reduces manufacturing energy requirements, allowing commercial glass to be melted and shaped far more efficiently during industrial processing.

39. (B) Laminated glass
Laminated glass is constructed by bonding a flexible plastic interlayer, typically polyvinyl butyral, between two sheets of ordinary window glass. Upon impact, the outer glass layers fracture, but the resulting shards adhere firmly to the internal plastic sheet. This structural design prevents flying glass fragments from causing severe injury, making it the mandatory safety glass for vehicle windshields.

40. (C) Tempered glass
Tempered glass is produced by subjecting standard glass to extreme thermal or chemical stress processes during manufacturing, introducing high surface compression. When fractured, tempered glass rapidly relieves internal stresses by breaking into tiny, blunt, relatively harmless dice-like fragments without sharp edges. Because of these safety characteristics, automotive manufacturers utilize tempered glass for side passenger windows and rear windshields.

41. (D) Supercooled liquid or amorphous solid
Physically, glass lacks the long-range ordered atomic lattice structure characteristic of true crystalline solids. Instead, as molten silica cools, it solidifies without undergoing crystallization, retaining a disordered atomic arrangement similar to that of a liquid. Consequently, forensic science defines glass as a supercooled liquid or an amorphous solid, yielding isotropic physical properties and random fracture propagation behavior.

42. (A) Speed of light in vacuum to speed of light in glass
Refractive index is a fundamental physical property used to characterize glass fragments. It is defined as the ratio of the speed of light in a vacuum to the speed of light traveling through the glass medium. As light enters glass, its velocity decreases, causing light rays to bend according to Snell's law based on composition and density.

43. (B) Disappearance of the Becke line
The immersion method determines glass refractive index by submerging fragments in a liquid medium. Under microscopic observation, a bright halo known as the Becke line appears around the fragment borders when refractive indices differ. By systematically altering liquid temperature or composition, the refractive indices match perfectly, causing the Becke line to disappear completely and rendering the glass invisible in solution.

44. (B) The glass has a higher refractive index than the immersion liquid.
The Becke line halo moves toward the material possessing the higher refractive index when the microscope objective is raised away from the sample. Therefore, if raising the objective causes the bright halo to move inward toward the center of the submerged glass fragment, the glass possesses a higher refractive index than the surrounding liquid, directing adjustment toward higher indices.

45. (A) Varying oil temperature while monitoring Becke line contrast
The Glass Refractive Index Measurement system automates precise refractive index determination. A tiny glass fragment is immersed in silicone oil within a temperature-controlled stage. As the oil is heated or cooled, a video camera continuously monitors boundary contrast and Becke line intensity. At match point, edge contrast reaches

Downloaded from www.pdf.tube

10. (A) Mitochondrial DNA
Telogen hairs shed naturally lack nucleated root sheath cells, making nuclear deoxyribonucleic acid extraction difficult or impossible. However, mitochondrial DNA is located outside the nucleus within cellular mitochondria and exists in hundreds to thousands of copies per cell. Mitochondrial DNA can be successfully recovered from the keratinized shaft, providing maternal lineage tracking when nuclear DNA is unavailable.

11. (B) The hair has been artificially bleached or dyed.
Microscopic hair examination helps detect artificial cosmetic treatments. Bleaching removes natural pigment granules uniform throughout the shaft, while chemical dyeing deposits synthetic color pigments along the cuticle and cortex. As hair continues to grow from the follicle, untreated natural hair emerges at the root, creating a sharp demarcation boundary between the dyed shaft and the original root color.

12. (B) Precise age determination is generally not possible, except for distinguishing infant hair from adult hair.
Physical examination of hair shafts cannot establish an individual's chronological age with high accuracy. The primary exception involves infant hairs, which display characteristic fine diameter, short length, underdeveloped pigmentation, and smooth structural features compared to adult hair. Beyond identifying infant characteristics, microscopic hair morphology lacks specific features required to determine precise age ranges across adult development.

13. (A) Medulla occupying more than half of the total shaft diameter
Animal hairs possess distinct structural parameters that separate them from human hairs. The most decisive feature is the medullary index, where the central medulla occupies greater than one-half of the total shaft diameter in animals, compared to one-third or less in humans. Furthermore, animals frequently exhibit complex patterned medullae and spinous or coronal cuticle scales.

14. (C) Pull 50 to 100 full-length hairs from different scalp regions.
Collecting representative standard control samples is essential for accurate forensic hair comparison due to natural variations across the human scalp. Standard guidelines dictate pulling fifty to one hundred full-length hairs from various scalp areas, including the frontal, parietal, occipital, and temporal regions. This ensures the sample encompasses the full range of colour, diameter, and medullary characteristics.

NODIA

15. (D) Absent or fragmented pattern
The medulla is the central cellular canal running through the hair shaft. In human head hair, the medulla is characteristically poorly developed, most often appearing as completely absent, fragmented, or interrupted along its length. Continuous medullae are exceedingly rare in human head hair, except among specific Mongoloid populations, making absent or fragmented configurations the standard finding.

16. (C) I and II only
Human hair growth involves three phases: anagen, catagen, and telogen. The anagen phase is the active growth stage lasting several years. The catagen phase represents a transitional stage lasting two to three weeks where growth stops. Nuclear DNA typing is most successful during anagen due to rich follicular tissue, whereas telogen hairs generally yield poor nuclear DNA.

17. (C) Assertion (A) is true but Reason (R) is false.
The medullary index is calculated by dividing the diameter of the central medulla by the total diameter of the hair shaft. This index serves as a primary metric for differentiating human from animal hair. However, animal hairs feature a significantly wider medulla relative to total shaft diameter, whereas human hairs possess a distinctly narrower medulla occupying less area.

18. (D) P-2, Q-4, R-1, S-3
Microscopic hair characteristics vary distinctly across racial groups and non-human species. Caucasian hair typically exhibits an oval cross-section with evenly distributed pigment. Mongoloid hair features a round cross-section with dense auburn or black pigment. Negroid hair possesses a flattened cross-section with dense, uneven pigment. Non-human animal hairs are uniquely characterized by spinous or coronal scale patterns.

19. (A) Rayon
Regenerated fibers are manufactured by chemically processing naturally occurring

55. (B) II, III, IV, I
The automated GRIM system measures glass refractive index through controlled heating. First, the glass fragment is submerged in standard silicone oil. Next, oil temperature is gradually altered to change its refractive index. A video system continuously monitors Becke line contrast until disappearance occurs at match point. Finally, the system automatically records the matching temperature to calculate the precise refractive index value.

56. (C) A physical fracture match fits the fragments to the headlamp assembly.
Class characteristics like refractive index, physical density, and trace elemental profiles can demonstrate that glass fragments are consistent with a specific lamp assembly, but they cannot individualize evidence. Only establishing a physical fracture match, where fracture edges fit together perfectly with the broken assembly, provides individual evidence proving the fragments originated exclusively from that single vehicle headlamp.

57. (D) Binder (Resin)
Paint is a complex chemical mixture designed for protective and decorative surface coatings. The fundamental component is the binder or resin, a polymeric material that holds pigment particles together in suspension. Binders form a tough, continuous film as solvents evaporate, ensuring strong adhesion to substrate surfaces and providing structural integrity to the cured multi-layered paint film.

58. (A) Electrocoat primer
Original automotive factory painting involves applying multiple specialized layers. The electrocoat primer is applied directly to treated vehicle sheet steel via electrodeposition. Composed of epoxy resin systems, this initial layer coats every surface and crevice to provide maximum corrosion resistance and prepare the metal substrate for subsequent primer surfacer and color coat adhesion during assembly line manufacturing.

59. (B) Basecoat
The basecoat, or colorcoat, provides the primary color, visual texture, and aesthetic finish of modern automotive paint systems. This layer contains organic and inorganic pigments, as well as metallic flakes or mica pearlescent additives. Basecoats are formulated to deliver precise color matching, opacity, and visual effects before being sealed under a protective non-pigmented glossy clearcoat layer.

60. (B) Clearcoat layer
Modern automotive finishing utilizes a clearcoat layer as the final protective coating over colored basecoats. This unpigmented polymer film consists of acrylic or polyurethane formulations designed to enhance gloss, depth, and smooth texture. Furthermore, clearcoats contain ultraviolet light absorbers and chemical stabilizers to shield underlying color pigments from environmental weathering, radiation degradation, scratch damage, and atmospheric exposure.

61. (A) Layer colour sequence and thickness
Stereomicroscopic evaluation is the critical first step in forensic paint comparison. Forensic examiners observe cross-sections of paint chips to evaluate the number of layers, color sequence, relative layer thickness, and surface textures. Finding matching multi-layered paint sequences establishes strong class evidence, particularly when repainting layers are present, significantly increasing the probability of a common source connection.

62. (C) Fourier Transform Infrared Spectrometer (FTIR)
Fourier Transform Infrared Spectroscopy combined with microscopy is the primary analytical tool for identifying paint binders. FTIR measures characteristic infrared absorption bands corresponding to specific organic functional groups within polymeric resin matrices. The resulting infrared spectrum acts as a unique chemical fingerprint, allowing examiners to distinguish between acrylic, alkyd, polyurethane, and epoxy binder formulations in microscopic paint chips.

63. (D) SEM-EDX elemental spectroscopy
Scanning Electron Microscopy coupled with Energy Dispersive X-ray Spectroscopy is the premier technique for analyzing inorganic elements in paint pigments and extenders. SEM provides high-magnification visualization of layer structures, while EDX detects characteristic X-rays emitted from the sample, yielding precise qualitative and quantitative elemental profiles of titanium, lead, chromium, barium, and other

Click Here to Buy book on Amazon

a minimum, allowing precise digital recording of the exact matching refractive index value.

46. (C) Flotation method using bromoform and bromobenzene
Determining density in tiny glass fragments requires sensitive techniques like the flotation method. A fragment is placed in a liquid mixture of bromoform and bromobenzene. By adjusting liquid proportions, a uniform density gradient is created until the glass remains suspended at a fixed depth. At this point, the liquid density equals the glass density, providing accurate physical property measurements.

47. (D) Radial cracks
When impact force strikes a pane of glass, high tensile stresses develop on the surface opposite the impact point. The glass fractures first by producing cracks that radiate outward from the point of impact like spokes on a bicycle wheel. These primary fractures are termed radial cracks, serving as crucial diagnostic features in evaluating fracture patterns and sequences.

48. (C) Reverse side of the force
The 3R rule is a fundamental forensic guideline used to determine the direction of impact force on fractured glass. It states that Radial cracks form Right angles on the Reverse side of the applied force. By examining microscopic curved stress lines along the broken edge of radial cracks, examiners determine which surface experienced force application.

49. (B) Wider on the exit side
High-velocity projectiles like bullets penetrating glass produce a characteristic cone or crater-shaped fracture hole. As the projectile impacts and passes through the pane, momentum pushes glass fragments outward in the direction of bullet movement. Consequently, the entrance hole remains relatively smooth and narrow, while the exit hole is distinctly wider with a flared, cratered opening on the exit surface.

50. (D) Hole A was created before Hole B.
Determining the chronological sequence of multiple projectile impacts on glass relies on fracture propagation principles. Fractures cannot propagate across existing cracks because stress waves terminate upon encountering pre-existing air gaps. When radial cracks from Hole B terminate at radial fractures radiating from Hole A, it proves that Hole A fractures existed first, conclusively establishing that Hole A preceded Hole B.

51. (A) Inductively Coupled Plasma Mass Spectrometry (ICP-MS)
Elemental composition analysis provides exceptional discrimination when comparing glass fragments with matching physical properties. Inductively Coupled Plasma Mass Spectrometry is an advanced, highly sensitive analytical technique capable of quantifying trace element impurities present at parts-per-million levels. Analyzing variations in trace elements allows forensic scientists to evaluate whether glass fragments share a common manufacturing batch or origin source.

52. (C) I and II only
Glass fracture propagation follows precise physical laws. Impact forces cause tensile stress on the side opposite the force, initiating radial cracks first. Continued bending causes tension on the front surface, producing concentric cracks second. In contrast, tempered glass does not yield typical long sharp splinters; instead, it shatters into small, blunt, dice-like fragments due to pre-existing internal surface stresses.

NODIA

53. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Glass is an amorphous solid lacking defined crystalline cleavage planes, causing cracks to propagate randomly along unique fracture paths during breakage. Because these fracture patterns are completely unique, physically rejoining separate glass fragments along matching fracture edges like a jigsaw puzzle provides individual identification, conclusively proving that the fragments originally formed a single unbroken glass object.

54. (D) P-3, Q-2, R-1, S-4
Distinct glass formulations serve specific functional roles. Borosilicate glass incorporates boron oxide to withstand thermal shock. Tempered glass undergoes rapid cooling to induce compressive surface stresses for safety. Laminated glass bonds two glass sheets around a flexible plastic inner layer to absorb impacts. Soda-lime glass represents the standard composition utilized in commercial window panes and everyday container glassware.

72. (C) P-4, Q-3, R-2, S-1
Specialized techniques target distinct chemical and physical properties in forensic paint analysis. Stereomicroscopy evaluates visual layer color sequence and thickness. Pyrolysis Gas Chromatography measures thermal decomposition products of organic polymer binders. SEM-EDX identifies inorganic elemental components of pigments and fillers. Fourier Transform Infrared Spectroscopy identifies functional groups within organic binder resins through infrared absorption spectra.

73. (D) Smoothing out seams and imperfections before colour application
The primer surfacer is an intermediate coating applied directly over the electrocoat primer in automotive paint systems. Highly pigmented with filler minerals, its primary function is to fill surface microscopic imperfections, smooth out body panel seams, and provide a uniform surface. Additionally, it improves adhesion between anticorrosive primers and decorative color basecoats, ensuring structural coating integrity.

74. (A) Humus
Forensic soil evidence encompasses a heterogeneous mixture of naturally occurring minerals, organic matter, and artificial environmental debris. The decomposed organic component of soil is termed humus, formed through the biological breakdown of plant and animal tissues by microorganisms. Humus contributes to soil color, texture, and moisture retention, offering valuable biological parameters during comparative forensic soil analysis.

75. (B) Munsell Soil Color Chart
Visual color comparison represents the crucial first step in forensic soil examination. Because soil color changes significantly with moisture content, samples are thoroughly dried under controlled conditions prior to evaluation. Dried soil colors are standardized and categorized by comparing them against the Munsell Soil Color Chart, which systematically defines soil hue, value, and chroma using standardized notation codes.

76. (B) Nested standard sieves
Soil texture is defined by the relative proportions of particle size fractions, including sand, silt, and clay. In forensic laboratories, particle size distribution profiling is performed by passing dried soil through a stack of nested standard sieves with decreasing mesh sizes. Weighing particle fractions retained on each sieve establishes a quantitative size distribution profile for comparison.

77. (A) Bromoform and bromobenzene
The density gradient tube method compares soil samples based on particle mass distribution across liquid densities. A glass tube is filled with liquid mixtures of bromoform and bromobenzene in varying proportions, creating a continuous density gradient from top to bottom. When soil particles are introduced, they sink until reaching liquid layers matching their density, producing characteristic density bands.

78. (C) I and II only
In density gradient analysis, soil particles sink through a liquid column until reaching a layer matching their specific mass density. Soil samples originating from the exact same source will display matching vertical band distributions. However, density gradient tube profiles provide comparative class evidence rather than individual identification, because soil cannot be individualized to a single pinpoint geographical location worldwide.

79. (D) Polarizing Light Microscope
Mineralogical analysis provides critical discrimination in forensic soil comparisons by identifying naturally occurring crystalline minerals. Forensic geologists utilize a polarizing light microscope to evaluate optical properties unique to individual mineral species, such as refractive index, cleavage angles, color, pleochroism, and birefringence. Determining relative mineral frequencies helps characterize geological origin and establish strong comparative links between soil samples.

80. (C) Forensic Palynology
Forensic palynology is the specialized discipline involving the collection, isolation, and microscopic examination of pollen grains and fungal spores in legal investigations. Because pollen distribution varies geographically, seasonally, and by plant species, palynological evidence can link suspects or evidence to specific geographic crime locations, prove environmental contact, track travel routes, and estimate seasonal timelines of criminal events.

Downloaded from www.pdf.tube

28. (B) Trilobal
The cross-sectional shape of synthetic fibers is determined by the geometric design of spinneret orifices used during extrusion. A trilobal cross-section is specifically engineered for synthetic carpet fibers, such as nylon and polyester. This three-lobed configuration efficiently scatters light to obscure accumulated dirt, while providing enhanced bulk and crush resistance, making cross-section analysis vital for end-use identification.

29. (A) Primary transfer
Physical evidence transfer occurs whenever objects or individuals interact. A primary transfer occurs when fibers are transferred directly from a source object or garment onto another surface through direct contact, such as an assailant grabbing a victim. Secondary transfer involves fibers moving from a primary receiver to a third surface, emphasizing the necessity of establishing direct transfer pathways.

30. (C) Comparison microscope
The comparison microscope consists of two independent optical microscopes joined by an optical bridge, presenting a split-field view to the examiner. This design allows side-by-side visual comparison of questioned fibers and known standard samples under identical illumination and magnification conditions. Examiners evaluate matching physical features, cross-sectional geometry, internal pigment distribution, surface characteristics, and longitudinal morphology simultaneously.

31. (D) I, II, and IV only
Natural silk is extruded continuously by silkworms as smooth filaments without surface cuticular scales. Synthetic polymers like nylon possess highly ordered molecular structures yielding significant birefringence under polarized light microscopy. Cross-sectional geometry serves as a key class characteristic for manufactured fibers. Microspectrophotometry non-destructively measures light absorption spectra of fiber dyes without chemical extraction or polymer damage.

32. (C) P-2, Q-4, R-1, S-3
Fibers are categorized by chemical origin and manufacturing process. Jute is a natural bast fiber derived from plant stems. Cashmere represents a natural protein hair fiber obtained from cashmere goats. Cellulose acetate is produced by chemically modifying natural wood cellulose into a regenerated fiber. Acrylic is a synthetic polymer synthesized entirely from acrylonitrile monomer petrochemical units.

NODIA

33. (D) Assertion (A) is false but Reason (R) is true.
Natural fibers such as cotton and wool exhibit variable cross-sectional shapes and inconsistent diameters due to biological growth irregularities. Conversely, synthetic fibers demonstrate high dimensional uniformity because they are manufactured by extruding molten polymer through precision spinnerets. This industrial extrusion process ensures tight control over cross-sectional geometry, fiber thickness, and physical dimensions throughout the manufacturing run.

34. (D) Asbestos
Plant fibers are natural cellulose-based materials harvested from various botanical sources, including seed hairs like cotton, bast fibers like hemp and jute, leaf fibers like sisal, and fruit fibers like coir. In contrast, asbestos is a naturally occurring silicate mineral composed of crystalline fibrous strands, representing the only naturally occurring mineral fiber used in industrial applications.

35. (A) Microscopic examination → Polarized light analysis → Microspectrophotometry → Destructive chemical testing
Forensic evidence examination strictly follows a logical hierarchy prioritizing non-destructive techniques before destructive methods. Initial examination begins with stereomicroscopic observation of color and structure, followed by polarized light microscopy to determine optical properties like birefringence. Non-destructive spectral dye analysis using microspectrophotometry comes next, reserving destructive chemical techniques like dye extraction or solvent solubility testing for the final analytical stage.

36. (C) Medullary index
Fiber characterization relies on evaluating physical and optical properties unique to polymeric materials. Refractive index, birefringence, and cross-sectional geometry represent standard parameters used to identify natural and synthetic fibers. In contrast, the medullary index specifically measures the ratio of central medulla diameter to total shaft

used exclusively in fingerprint examination rather than soil analysis.

90. (A) Transfers easily on contact and offers strong local class evidence.
Soil is an exemplary trace material governed by Locard's Exchange Principle. Its particulate nature allows easy transfer and adherence to footwear, clothing, tools, and vehicle tires upon physical contact. Because soil composition varies significantly across small geographical distances, matching soil profiles yields compelling class evidence linking a suspect or item directly to a specific crime scene location.

www.nodia.in

Click Here to Buy book on Flipkart

CHAPTER 12

Blood and Body Fluid Identification and Serology

1. In forensic serology, what is the primary difference between blood plasma and blood serum?
(A) Plasma contains red blood cells, whereas serum does not.
(B) Plasma contains coagulation factors like fibrinogen, whereas serum does not.
(C) Serum contains coagulation factors like fibrinogen, whereas plasma does not.
(D) Plasma is the cellular component, whereas serum is the liquid matrix.

2. Which of the following formed elements of human blood lacks a true nucleus in its mature state and is primarily responsible for oxygen transport?
(A) Leukocyte
(B) Thrombocyte
(C) Macrophage
(D) Erythrocyte

3. What is the fundamental structure of a human haemoglobin molecule?
(A) Four globin chains and four heme groups containing iron
(B) Two globin chains and two heme groups containing copper
(C) Four globin chains and four heme groups containing magnesium
(D) Two globin chains and four heme groups containing iron

4. When blood is shed at a crime scene and strikes a surface at an angle of 90 degrees, what is the most likely shape of the resulting parent bloodstain?
(A) Highly elongated oval
(B) Exclamation mark shape
(C) Perfect or near-perfect circle
(D) Triangular shape

5. What is the primary function of an Alternate Light Source (ALS) when locating latent bloodstains at a crime scene?
(A) To enhance contrast of the stain against the substrate
(B) To make latent bloodstains fluoresce without reagents
(C) To react chemically with iron present inside haemoglobin
(D) To crystallize cellular components for rapid collection

6. Which of the following is the underlying principle behind standard presumptive tests for blood, such as the Kastle-Meyer test?
(A) The antigen-antibody reaction of human serum
(B) The precipitation of blood proteins in an acidic medium
(C) The specific binding of dyes to the globin chains
(D) The peroxidase-like activity of the heme group

7. The Benzidine test was historically widely used as a presumptive test for blood. Why has its use been largely discontinued in modern forensic science laboratories?
(A) It lacks sensitivity to human blood.
(B) The reagent is a known strong carcinogen.
(C) It requires excessive heating to produce a color change.
(D) It only works on liquid bloodstains.

8. In the Kastle-Meyer (Phenolphthalein) presumptive test for blood, what color change indicates a positive reaction?
(A) Blue-green
(B) Deep purple
(C) Bright pink
(D) Yellow-orange

9. Which color change is characteristic of a positive Leucomalachite Green (LMG) test for the presumptive identification of blood?
(A) Bright pink
(B) Deep purple
(C) Vivid orange
(D) Blue-green

NODIA

10. Match the formed elements of blood in List I with their primary physiological function in List II.
List I: Formed Elements of Blood
P. Erythrocytes
Q. Leukocytes
R. Thrombocytes
S. Plasma
List II: Physiological Function
1. Defence against infection
2. Transport of oxygen
3. Suspension medium for cells
4. Blood coagulation
(A) P-2, Q-1, R-4, S-3
(B) P-1, Q-2, R-3, S-4
(C) P-2, Q-4, R-1, S-3
(D) P-3, Q-1, R-4, S-2

11. Which chemical is routinely used as the oxidizing agent in the Kastle-Meyer and Leucomalachite Green presumptive tests?
(A) Sodium hypochlorite
(B) Hydrogen peroxide
(C) Potassium permanganate
(D) Nitric acid

12. Which of the following is a known disadvantage of using Luminol to detect latent bloodstains at a crime scene?
(A) It is highly specific to human blood while ignoring non-human biological samples.
(B) It yields false positives with copper and household bleach.
(C) It destroys all nuclear DNA present in the stain on contact.
(D) It requires continuous illumination from an Alternate Light Source to remain visible.

13. What is a significant practical advantage of using Bluestar reagent over traditional Luminol preparations at a crime scene?
(A) Luminescence can be observed without complete darkness.
(B) It does not cross-react with non-human animal bloodstains.
(C) It acts as both a presumptive and confirmatory test simultaneously.
(D) It functions effectively without requiring hydrogen peroxide reagent.

14. Which reagent requires illumination with an Alternate Light Source (typically around 450 nm) and the use of orange barrier filters to view the resulting emission when detecting latent bloodstains?
(A) Kastle-Meyer reagent
(B) Luminol
(C) Fluorescein
(D) Benzidine

15. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Plant materials such as horseradish and potatoes can cause a false positive reaction in the Kastle-Meyer test.
Reason (R): These plant materials contain peroxidases that can catalyze the breakdown of hydrogen peroxide in a manner similar to haemoglobin.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

NODIA

16. A presumptive test for blood is performed, and a color change occurs immediately upon adding the colour reagent but BEFORE the hydrogen peroxide is added. How should a forensic scientist interpret this?
(A) The test result is considered a strongly positive indication of blood.
(B) The biological sample is confirmed to be originating from human blood.
(C) It is invalid due to endogenous oxidants in the sample.
(D) The chemical reagent is expired and lacks adequate test sensitivity.

17. The Teichmann test is a confirmatory microcrystalline test for blood. What specific crystals are formed in a positive Teichmann test?
(A) Pyridine hemochromogen crystals
(B) Hematin chloride crystals
(C) Spermine picrate crystals
(D) Choline periodide crystals

18. Which of the following microcrystalline tests for blood produces characteristic pink, feathery or needle-like crystals under a microscope?
(A) Teichmann test
(B) Florence test
(C) Barberio test
(D) Takayama test

39. Which of the following is considered a confirmatory microcrystalline test for the presence of semen?
(A) Phadebas test
(B) Florence test
(C) Jaffe test
(D) Kastle-Meyer test

40. Given below are statements regarding the identification of menstrual blood:
I. It typically lacks clotting ability due to high plasminogen activator levels.
II. It contains characteristic endometrial cells.
III. It can be easily distinguished from venous blood by the Kastle-Meyer test alone.
Which of the above statements is/are correct?
(A) I and II
(B) II and III
(C) I and III
(D) I, II and III

41. The Barberio test is a microcrystalline test used for semen identification. What specific substance in semen does this test react with?
(A) Choline
(B) Acid phosphatase
(C) Prostate specific antigen
(D) Spermine

42. Arrange the following steps of the Kastle-Meyer test procedure in the correct order:
I. Apply a drop of hydrogen peroxide.
II. Lightly rub a moistened cotton swab over the suspected stain.
III. Observe for a rapid pink color change.
IV. Apply a drop of Kastle-Meyer reagent (phenolphthalein) to the swab.
Which of the following sequences is correct?
(A) II, I, IV, III
(B) II, IV, I, III
(C) IV, I, II, III
(D) I, II, IV, III

43. What is the characteristic shape and color of the crystals formed during a positive Barberio test for semen?
(A) Brown rhombic-shaped crystals
(B) Yellow needle crystals
(C) Pink feathery-like crystals
(D) Blue square-shaped crystals

44. What term describes a medical condition where a male's ejaculate contains seminal fluid but completely lacks spermatozoa?
(A) Oligospermia
(B) Azoospermia
(C) Aspermia
(D) Teratospermia

45. Given below are methods and markers used in forensic serology:
I. Detection of human specific DNA sequences.
II. Ouchterlony double diffusion.
III. Measurement of alpha-amylase activity.
IV. Cross-over immunoelectrophoresis.
Which of the above techniques are primarily used to determine the species of origin of a bloodstain?
(A) I and III
(B) II and IV
(C) I, II and IV
(D) I, II, III and IV

46. Prostate Specific Antigen (PSA), widely used as a confirmatory marker for seminal fluid, is also commonly known in forensic science by what designation?
(A) p53
(B) Amylase
(C) p30
(D) Hematin

47. In sexual assault cases, the "Christmas Tree Stain" is frequently used to microscopically identify spermatozoa. Which two dyes make up this stain?
(A) Hematoxylin solution and Eosin stain
(B) Crystal Violet dye and Safranin solution
(C) Methylene Blue dye and Eosin counterstain
(D) Fast Red and picroindigocarmine

48. When examining spermatozoa stained with the Christmas Tree Stain, what color do the sperm heads predominantly appear?
(A) Green
(B) Blue
(C) Red
(D) Yellow

49. Why is the p30 (PSA) test especially valuable in forensic examinations of sexual assault evidence?
(A) It definitively proves the exact time the sexual assault occurred.
(B) It detects semen even in azoospermic cases.
(C) It conclusively identifies the secretor blood group of the suspect.
(D) It functions exclusively on freshly collected liquid semen samples.

Downloaded from www.pdf.tube

(B) Hemochromogen
(C) Carboxyhemoglobin
(D) Hematin

30. Match the forensic serological tests in List I with their corresponding target or crystal in List II.
List I: Test
P. Teichmann Test
Q. Takayama Test
R. Ouchterlony Test
S. Kastle-Meyer Test
List II: Target / Result
1. Antigen-antibody precipitation line
2. Phenolphthalein color change
3. Pyridine hemochromogen crystals
4. Hematin chloride crystals
(A) P-4, Q-3, R-1, S-2
(B) P-3, Q-4, R-1, S-2
(C) P-4, Q-3, R-2, S-1
(D) P-1, Q-2, R-3, S-4

31. Which of the following is a strong indicator that a bloodstain originated from menstrual blood rather than a peripheral venous wound?
(A) Presence of high concentrations of ciliated epithelial cells
(B) Absence of red blood cells
(C) High concentration of amylase
(D) Absence of fibrinogen and presence of endometrial cells

32. Which of the following is the correct chronological sequence for processing a suspected bloodstain found at a crime scene?
(A) Visual examination → Confirmatory test → Presumptive test → Species determination
(B) Visual examination → Presumptive test → Confirmatory test → Species determination
(C) Presumptive test → Visual examination → Species determination → Confirmatory test
(D) Species determination → Confirmatory test → Presumptive test → Visual examination

33. Which microscopic feature helps a forensic scientist identify blood originating from the nasal cavity?
(A) Squamous epithelial cells with high glycogen content
(B) Ciliated columnar epithelial cells and mucus
(C) Endometrial tissue fragments
(D) Complete absence of leukocytes

34. What distinguishes blood originating from a traumatic wound from other specialized physiological blood origins?
(A) It completely lacks any measurable amount of haemoglobin molecules.
(B) It is naturally and entirely incoagulable under standard conditions.
(C) It consistently contains very large amounts of active digestive pepsin.
(D) It may contain skin or muscle fragments.

NODIA

35. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): The anti-human globulin (AHG) test can be utilized to identify the human origin of minute or highly degraded bloodstains.
Reason (R): The AHG method involves detecting specific human immunoglobulins that remain stable even when normal precipitin reactions fail.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

36. What are the two primary components of human semen?
(A) Human erythrocytes and blood plasma
(B) Salivary amylase and buccal epithelial cells
(C) Spermatozoa and seminal plasma
(D) Concentrated urea and creatinine compounds

37. Which enzyme is found in abnormally high concentrations in human semen, making it the primary target for presumptive semen testing?
(A) Acid phosphatase
(B) Alpha-amylase
(C) Alkaline phosphatase
(D) Pepsin

38. In the standard Acid Phosphatase (AP) test for semen, what color indicates a rapid positive reaction when the extract reacts with alpha-naphthyl phosphate and Brentamine Fast Blue B salt?
(A) Bright vibrant pink
(B) Dark blue-green
(C) Distinct yellow
(D) Intense purple

19. What is an advantage of the Takayama test over the Teichmann test when examining difficult bloodstains?
(A) It works better on older bloodstains and requires less heating.
(B) It can be easily performed and interpreted without using a light microscope.
(C) It definitively determines the species of origin of the target bloodstain.
(D) It uses entirely non-toxic and environmentally safe chemical reagents.

20. Given below are statements regarding the presumptive tests for blood:
I. The Kastle-Meyer test uses phenolphthalein, which turns pink in a positive reaction.
II. Luminol emits chemiluminescence and does not require an alternate light source.
III. Presumptive tests are conclusive proof of the presence of human blood.
Which of the above statements is/are correct?
(A) I and II
(B) II and III
(C) I and III
(D) I, II and III

21. Spectroscopic examination of blood relies on identifying specific absorption bands. Which derivative of haemoglobin shows two characteristic absorption bands in the green-yellow region of the spectrum?
(A) Oxyhemoglobin
(B) Methemoglobin
(C) Sulfhemoglobin
(D) Carboxyhemoglobin

22. The precipitin test used in forensic serology is based on which fundamental biological interaction?
(A) Enzyme-substrate binding
(B) DNA hybridization
(C) Protein denaturation by acid
(D) Antigen-antibody reaction

23. In the traditional precipitin tube test for determining the species origin of blood, what indicates a positive reaction for human blood?
(A) A rapid and distinct color change to deep blue inside the tube
(B) A precipitin ring forms at the interface.
(C) The continuous formation of gas bubbles at the liquid interface
(D) The complete dissolution of all solid particulates in the solution

24. Which animal is most commonly used in forensic laboratories to raise the anti-human serum required for the precipitin test?
(A) Guinea pig
(B) Mouse
(C) Rabbit
(D) Rhesus monkey

25. Given below are techniques used in forensic serology:
I. Benzidine test
II. Teichmann test
III. Takayama test
IV. Immunoelectrophoresis
Which of the above are considered confirmatory crystal tests for blood?
(A) I and II
(B) II and III
(C) III and IV
(D) I, II and III

26. Which technique relies on antibodies and antigens diffusing towards each other in an agar gel to form a visible line of precipitation?
(A) Ouchterlony double diffusion
(B) Immunoelectrophoresis
(C) High-performance liquid chromatography
(D) Spectrophotometry

27. What is a known limitation of the precipitin test when determining if a bloodstain is of human origin?
(A) It cross-reacts completely with blood from all domestic and wild animals.
(B) It cross-reacts with blood of higher primates like chimpanzees.
(C) It cannot be successfully performed on dried or aged forensic bloodstains.
(D) It requires the collected bloodstain evidence to be less than 24 hours old.

28. Which method combines electrophoretic separation of proteins with immunodiffusion to specifically identify human serum proteins?
(A) Ring precipitin test
(B) Immunoelectrophoresis
(C) Gel diffusion
(D) Antihuman globulin (Coombs) test

29. When estimating the age of a bloodstain visually and chemically, a change in color from bright red to dark brown is primarily due to the conversion of haemoglobin into which substance?
(A) Methemoglobin

Click Here to Buy book on Amazon

50. Match the crystal tests in List I with the specific chemical compounds they form in List II.
List I: Test
P. Teichmann Test
Q. Florence Test
R. Barberio Test
S. Takayama Test
List II: Chemical Compound Formed
1. Spermine picrate
2. Pyridine hemochromogen
3. Hematin chloride
4. Choline periodide
(A) P-3, Q-4, R-1, S-2
(B) P-4, Q-3, R-2, S-1
(C) P-3, Q-1, R-4, S-2
(D) P-2, Q-4, R-1, S-3

51. Which of the following can cause a false positive reaction in the Acid Phosphatase test if interpreted incorrectly over a long duration?
(A) Vaginal secretions and fungi
(B) Fresh human sweat and eccrine secretions
(C) Human tear secretions and fresh saliva stains
(D) Intact head hair shafts and follicle cells

52. When searching for saliva stains on clothing, forensic scientists typically test for the presence of which enzyme?
(A) Pepsin
(B) Trypsin
(C) Alpha-amylase
(D) Acid phosphatase

53. The Starch-Iodine test is a traditional method for indicating the presence of saliva. In a positive reaction where amylase has digested the starch, what is the expected result?
(A) No blue-black complex is formed.
(B) The test area immediately turns a bright pink color.
(C) The test area rapidly forms a dark blue-black complex.
(D) The test area fluoresces brightly green under UV light.

54. The Phadebas test is widely used in forensic laboratories. What does a positive Phadebas test indicate?
(A) High levels of urea
(B) The presence of spermatozoa
(C) The presence of human haemoglobin
(D) High levels of alpha-amylase

NODIA

55. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Acid phosphatase activity in the vaginal tract decreases significantly and is usually undetectable after 48 to 72 hours post-coitus.
Reason (R): Acid phosphatase is a highly unstable enzyme in the vaginal environment and is naturally degraded and cleared by physiological drainage.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

56. Which two chemical compounds are primarily targeted when forensically identifying urine stains?
(A) Amylase and Glycogen
(B) Acid phosphatase and Spermine
(C) Urea and Creatinine
(D) Lactic acid and Urobilinogen

57. The Jaffe test is used to detect the presence of creatinine in suspected urine stains. Which reagent is used in this test to form a characteristic red-orange compound?
(A) Nessler's reagent
(B) Phenolphthalein
(C) Silver nitrate
(D) Picric acid

58. The Urease test for urine relies on the enzyme urease breaking down urea. What gas is released in this reaction to cause a detectable pH shift?
(A) Ammonia
(B) Carbon dioxide
(C) Oxygen
(D) Nitrogen

59. Which compound is targeted by the Edelman test to confirm the presence of faecal matter in forensic exhibits?
(A) Active pepsin
(B) Urobilinogen
(C) Human dermicidin
(D) Serum creatinine

60. Given below are statements regarding Prostate Specific Antigen (p30):
I. It is a glycoprotein secreted by the prostate

gland.
II. It is present in human semen regardless of the presence of spermatozoa.
III. It can be reliably identified using immunochromatographic test strips.
Which of the above statements is/are correct?
(A) I and II
(B) II and III
(C) I and III
(D) I, II and III

61. Which of the following is a significant limitation of using alpha-amylase tests for the conclusive identification of saliva?
(A) It is present in other fluids like serum, sweat, and milk.
(B) Alpha-amylase is rapidly destroyed within 10 minutes upon exposure to ambient air.
(C) Alpha-amylase is completely absent in approximately 20% of the normal human population.
(D) The chemical test reagents utilized in the assay are highly toxic and radioactive.

62. Vaginal fluid identification heavily relies on the microscopic observation of specific cells. What are these cells, and what do they primarily contain?
(A) Ciliated columnar cells containing mucus
(B) Endometrial cells containing plasminogen
(C) Squamous epithelial cells containing glycogen
(D) Leukocytes containing distinct multi-lobed nuclei

63. Which stain is commonly used in forensic microscopy to identify the glycogen-rich epithelial cells characteristic of vaginal fluid?
(A) Methylene blue
(B) Eosin Y
(C) Fast Blue B
(D) Lugol's iodine

64. Forensic identification of vomit often relies on observing highly acidic pH levels and the detection of which specific stomach enzyme?
(A) Trypsin
(B) Amylase
(C) Pepsin
(D) Urease

65. The detection of the antimicrobial peptide dermicidin or high levels of lactic acid on a piece of clothing suggests the presence of which body fluid?
(A) Saliva
(B) Sweat
(C) Urine
(D) Vaginal fluid

66. How can human breast milk be differentiated from cow's milk in a forensic context?
(A) By chemically testing for the presence of lactose sugar
(B) By observing the complete absence of fat in human milk samples
(C) By evaluating visual color differences under standard lighting
(D) By species-specific immunological assays

67. In recent forensic research, which advanced molecular technique allows for the identification of specific body fluids based on tissue-specific gene expression?
(A) mRNA (messenger RNA) profiling
(B) Mitochondrial DNA sequencing
(C) Y-STR profiling
(D) Gas Chromatography

68. What is the primary disadvantage of using RNA profiling for body fluid identification compared to traditional DNA analysis?
(A) RNA profiling is significantly less specific to different human body fluid types.
(B) RNA molecules cannot be successfully amplified using standard PCR techniques.
(C) RNA degrades much faster than DNA in the environment.
(D) RNA lacks standard nucleotide bases present in cellular genetic material.

69. Epigenetic markers are increasingly used in forensic science to identify body fluids. What specific molecular modification is analyzed in these assays?
(A) DNA methylation
(B) Enzymatic protein phosphorylation
(C) Intracellular lipid oxidation
(D) Hydrolytic carbohydrate cleavage

70. Match the body fluid or material in List I with the primary chemical marker used for its forensic identification in List II.
List I: Body Fluid or Material
P. Saliva
Q. Urine
R. Faecal matter
S. Semen
List II: Primary Chemical Marker

Downloaded from www.pdf.tube

1. Urobilinogen
2. Alpha-amylase
3. Acid phosphatase
4. Creatinine

(A) P-2, Q-4, R-1, S-3
(B) P-3, Q-1, R-4, S-2
(C) P-2, Q-3, R-1, S-4
(D) P-4, Q-2, R-1, S-3

71. Proper preservation of biological evidence is critical. What is the standard protocol for handling a bloodstained shirt recovered from a crime scene before packaging?
(A) Package it immediately inside an airtight plastic bag to retain essential moisture.
(B) Air-dry at room temperature away from sunlight.
(C) Wash all surrounding unstained areas thoroughly to prevent cross-contamination.
(D) Freeze the shirt immediately in a laboratory freezer while it is still wet.

72. Which type of packaging material is strictly recommended for transporting dried biological evidence to a forensic science laboratory to prevent fungal growth?
(A) Airtight plastic zip-lock storage bags
(B) Sealed heavy-duty metal cans
(C) Paper bags or paper envelopes
(D) Sealed glass jars filled with saline solution

73. What is the most common consequence of storing biological evidence, such as wet semen stains, in airtight plastic containers without prior drying?
(A) Substantial enhancement of the recovered DNA profile quality
(B) Irreversible crystallization of the seminal acid phosphatase enzyme
(C) Chemical conversion of cellular blood components into methemoglobin
(D) Rapid decay from bacterial and fungal growth

74. How should a forensic scientist definitively report the finding of a positive Kastle-Meyer test on a reddish-brown stain?
(A) "The stain may contain blood."
(B) "The tested stain is unequivocally confirmed as human blood."
(C) "The tested stain contains high quality recoverable human DNA."
(D) "The tested stain is conclusively confirmed as non-human animal blood."

75. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): The detection of both urea and creatinine in a stain provides strong forensic evidence for the presence of urine.
Reason (R): Urea and creatinine are found exclusively in urine and are completely absent in blood, saliva, and sweat.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

76. Historically, classical forensic serology heavily relied on blood grouping. In the ABO system, what is the term used when red blood cells clump together upon reacting with a specific antiserum?
(A) Coagulation
(B) Agglutination
(C) Precipitation
(D) Hemolysis

NODIA

77. Which antigen forms the foundational precursor molecule on the surface of red blood cells, which is then modified to become the A or B antigen?
(A) H antigen
(B) D antigen
(C) M antigen
(D) N antigen

78. In forensic serology, an individual whose ABO blood group antigens are secreted into other body fluids like saliva and semen is termed a "secretor". This trait is controlled by which gene?
(A) Amelogenin gene
(B) FUT1 (H) gene
(C) FUT2 (Se) gene
(D) RhD gene

79. Approximately what percentage of the general population are "secretors", allowing their blood group to be determined from their saliva or semen?
(A) 20%
(B) 50%
(C) 100%
(D) 80%

80. Given below are statements regarding the relationship between serology and DNA analysis:
I. Presumptive serological tests help locate stains for subsequent DNA analysis.
II. Serological tests destroy the DNA present, making subsequent profiling impossible.
III. The interpretation of a mixed DNA profile can be aided by knowing which body fluids are present (e.g., semen and vaginal fluid).
Which of the above statements is/are correct?
(A) I and II
(B) II and III
(C) I and III
(D) I, II and III

81. Which classical serological technique was widely used to determine the ABO blood group of dried bloodstains by observing whether specific antibodies were removed from a known antiserum?
(A) Traditional Lattes Crust method
(B) Absorption-Inhibition
(C) Microchemical Jaffe test
(D) Double gel diffusion assay

82. Which of the following is the correct sequence of steps for processing a vaginal swab from a sexual assault kit in the forensic laboratory?
(A) DNA Extraction → Acid Phosphatase test → Microscopic sperm search
(B) Microscopic sperm search → DNA Extraction → Acid Phosphatase test
(C) Acid Phosphatase test → Microscopic sperm search → DNA Extraction
(D) Acid Phosphatase test → DNA Extraction → Microscopic sperm search

83. When a forensic analyst adds a drop of phenolphthalein reagent to a suspected bloodstain and it turns pink BEFORE the addition of hydrogen peroxide, what should be the immediate conclusion?
(A) An interfering oxidant is present.
(B) The test is functioning perfectly and definitively confirms blood.
(C) The biological stain is conclusively identified as non-human animal blood.
(D) The biological stain is extremely fresh and contains active haemoglobin.

84. When preparing the Kastle-Meyer stock solution in a forensic laboratory, phenolphthalein must be reduced to its colorless form (phenolphthalin). Which chemical is traditionally boiled with phenolphthalein and potassium hydroxide to achieve this reduction?
(A) Iron filings
(B) Copper sulphate
(C) Zinc dust
(D) Magnesium ribbon

85. Given below are practices for handling serological evidence at a crime scene:
I. Wet items should be packed directly into airtight plastic bags to prevent drying.
II. Bloodstains on walls should be scraped into a paper fold or collected on a moistened swab.
III. Evidence should be kept away from direct sunlight and heat.
IV. Paper bags or envelopes are preferred for packaging dried clothing.
Which of the above practices are correct?
(A) I, II and III
(B) II, III and IV
(C) I, III and IV
(D) I, II, III and IV

86. Which classical method directly detects ABO agglutinins (antibodies) in a dried bloodstain by applying known A, B, and O red blood cells to the crust?
(A) Absorption-Elution method
(B) Teichmann method
(C) Immunoelectrophoresis
(D) Lattes Crust method

87. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Blood samples drawn from a suspect for forensic DNA and serological typing are usually collected in tubes containing EDTA.
Reason (R): EDTA acts as a preservative by chelating magnesium ions, which inhibits DNA-degrading nucleases and prevents blood coagulation.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

88. Arrange the following administrative and procedural steps for processing serological evidence received at a Forensic Science Laboratory in the correct operational order:

Click Here to Buy book on Flipkart

I. Forwarding of confirmed positive human blood/semen samples to the DNA profiling division.
II. Registration and entry of the sealed parcels at the lab receipt/case acceptance section.
III. Opening the parcel and conducting presumptive and confirmatory tests by the Serology division.
IV. Verifying the integrity of the police seals against the forwarded specimen seal impressions.

Which of the following sequences is correct?
(A) II, IV, III, I
(B) II, III, IV, I
(C) IV, II, III, I
(D) III, IV, II, I

89. Given below are statements regarding the legal procedures for collecting serological evidence from an accused in a sexual offense case:
I. The medical examination must be conducted by a registered medical practitioner.
II. The examination can only proceed with the consent of the accused or by the use of reasonable force upon the request of a police officer not below the rank of Sub-Inspector.
III. The material collected from the examination must be sealed and forwarded to the Forensic Science Laboratory.
IV. A police officer can independently extract blood from the accused without medical assistance.

Which of the above statements are correct?
(A) I, II and III
(B) II, III and IV
(C) I, III and IV
(D) I and III only

90. Match the foundational forensic scientists in List I with their specific contribution to serology and body fluid identification in List II.
List I: Scientist
P. Paul Uhlenhuth
Q. Karl Landsteiner
R. Leon Lattes
S. Masao Takayama
List II: Contribution
1. Discovery of the ABO blood groups
2. Pyridine hemochromogen crystal test
3. Development of the precipitin test for species origin
4. Procedure to determine blood group from dried stains
(A) P-3, Q-1, R-4, S-2
(B) P-1, Q-3, R-2, S-4
(C) P-3, Q-4, R-1, S-2
(D) P-4, Q-1, R-3, S-2

www.nodia.in

Downloaded from www.pdf.tube

temperature in a protected area away from direct heat and sunlight prior to packaging. Drying prevents microbial proliferation and enzymatic degradation that rapidly destroy cellular structures and nuclear DNA. Moist biological samples should never be sealed in plastic or exposed to direct heat during preservation.

72. (C) Paper bags or paper envelopes
Forensic standards dictate that dried biological evidence must be packaged in breathable paper containers, such as paper bags or envelopes. Paper packaging allows residual moisture to evaporate, preventing condensation and humidity accumulation. This dry environment inhibits bacterial and fungal growth that would otherwise accelerate the enzymatic degradation of DNA and alter biochemical markers present on biological exhibits.

73. (D) Rapid decay from bacterial and fungal growth
Packaging wet biological evidence, such as semen stains, inside non-breathable plastic containers traps ambient moisture and creates a humid microenvironment. These conditions accelerate the proliferation of putrefactive bacteria and fungi naturally present on evidence. Microbial growth generates nucleases and digestive enzymes that rapidly degrade cellular proteins and genomic DNA, rendering subsequent forensic DNA profiling unsuccessful.

74. (A) "The stain may contain blood."
The Kastle-Meyer test is a preliminary catalytic screening assay that detects peroxidase-like activity. Because plant peroxidases, chemical oxidants, and non-human animal blood can also trigger a positive color reaction, a positive Kastle-Meyer result cannot confirm the presence or species origin of blood. Therefore, analysts must report the finding cautiously, stating that the tested stain may contain blood.

75. (C) Assertion (A) is true but Reason (R) is false.
Concurrently detecting elevated concentrations of both urea and creatinine provides strong forensic evidence for identifying urine in biological stains. However, these metabolic waste compounds are not strictly exclusive to urine; trace amounts of urea and creatinine circulate in blood serum and are excreted in sweat and saliva. Thus, Assertion (A) is true, but Reason (R) is false due to absolute exclusivity claims.

76. (B) Agglutination
In classical ABO blood group typing, red blood cells express specific carbohydrate surface antigens. When red blood cells harboring a specific antigen encounter corresponding bivalent antibodies in antiserum, the antibodies bind and cross-link adjacent red cells together. This immunological cross-linking causes visible clumping of red blood cells, a biological reaction termed agglutination, which forms the basis of serological blood grouping.

77. (A) H antigen
The H antigen serves as the essential glycolipid precursor substrate located on human erythrocyte membranes. Glycosyltransferase enzymes encoded by ABO blood group alleles modify this foundation; the A allele adds N-acetylgalactosamine, while the B allele adds D-galactose to the H antigen. Individuals with O blood group leave the H antigen unmodified, retaining it as the foundational cell surface structure.

78. (C) FUT2 (Se) gene
Secretor status in humans is governed by the FUT2 gene, which encodes alpha-1,2-fucosyltransferase-2. This enzyme adds fucose to precursor molecules in exocrine glands, producing soluble H antigen that is subsequently converted into A or B antigens in mucosal secretions like saliva, semen, and gastric juice. Individuals carrying at least one functional dominant Se allele express secretor activity in body fluids.

79. (D) 80%
Approximately eighty percent of the general human population are secretors, possessing at least one functional dominant FUT2 allele. Secretors express soluble ABO blood group antigens in their body fluids, including saliva, semen, sweat, and vaginal secretions. The remaining twenty percent of individuals are non-secretors who express ABO antigens exclusively on cell membranes like red blood cells, but not in exocrine fluids.

80. (C) I and III
Presumptive serological tests locate biological stains for downstream DNA analysis, and identifying specific body fluids helps interpret complex mixed DNA profiles in sexual assault cases. Serological tests do not destroy DNA when performed correctly using minimal sampling.

NODIA

STUDYING FROM PDFs?

THINK AGAIN.

If you are studying only from PDFs,
you are wasting valuable time.

Research shows that learning from

PRINTED BOOKS has up to

4× HIGHER RETENTION

than studying from screens.

PRINT BOOK = BETTER MEMORY

PDF = LOWER RETENTION

Those who study from **PRINTED BOOKS**
move **AHEAD.**

Others are left **BEHIND**
in competition.

In competitive exams,
being average is not enough.

STAY ONE STEP AHEAD.

9. (D) Blue-green
Leucomalachite green is a reduced, colorless triphenylmethane dye utilized in forensic screening tests for bloodstain evidence. Upon oxidation catalyzed by the heme group of hemoglobin in the presence of hydrogen peroxide, the dye converts to its oxidized, highly colored form. This specific chemical oxidation generates a vivid blue-green color, which serves as a positive indicator during preliminary blood testing.

10. (A) P-2, Q-1, R-4, S-3
Human blood consists of specialized cellular and fluid elements performing distinct physiological functions. Erythrocytes carry oxygen via hemoglobin, leukocytes provide immunological defense against cellular pathogens, thrombocytes facilitate blood coagulation and clot formation, and plasma acts as the liquid matrix suspending these formed cellular elements. These physiological associations correspond to the matched sequence of cellular roles in human circulatory biology.

11. (B) Hydrogen peroxide
Hydrogen peroxide serves as the essential oxidizing agent in catalytic color tests, such as the Kastle-Meyer and Leucomalachite Green tests. The heme moiety of hemoglobin acts as a peroxidase catalyst, cleaving hydrogen peroxide to produce reactive oxygen species. These oxygen radicals subsequently oxidize the reduced color indicator present in the reagent, yielding the characteristic color change that indicates blood.

12. (B) It yields false positives with copper and household bleach.
Luminol is a chemiluminescent chemical reagent used to detect hidden or trace bloodstains at crime scenes. A major limitation of luminol is its cross-reactivity with non-blood catalysts. Chemical oxidants like household bleach and metallic ions like copper or iron induce false positive chemiluminescence, potentially misleading investigators during initial scene search and evidence collection efforts.

13. (A) Luminescence can be observed without complete darkness.
Bluestar is a chemiluminescent formulation designed to overcome limitations associated with traditional luminol mixtures in forensic field operations. It produces an intense blue luminescence upon reacting with the heme group of blood, which allows clear visualization and photographic documentation in ambient or partial light without requiring absolute darkness at the crime scene, improving operational efficiency during investigations.

14. (C) Fluorescein
Fluorescein is a fluorescent reagent used for detecting latent, washed, or trace bloodstains on various crime scene surfaces. The reaction requires illumination with an alternate light source, typically set to blue light around four hundred fifty nanometers. Viewing through orange barrier filters allows investigators to visualize the bright yellow-green fluorescence emitted by fluorescein, isolating the signal from ambient background reflections.

15. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Plant tissues from horseradish and potatoes naturally express vegetable peroxidase enzymes, such as horseradish peroxidase. These botanical enzymes possess catalytic capabilities similar to the heme group of hemoglobin, catalyzing the decomposition of hydrogen peroxide and oxidizing phenolphthalin to phenolphthalein. Consequently, plant material causes false positive reactions in the Kastle-Meyer test through this precise shared enzymatic mechanism.

16. (C) It is invalid due to endogenous oxidants in the sample.
Standard presumptive color tests require sequential addition of the reduced dye indicator followed by hydrogen peroxide. If a color change occurs immediately upon adding the dye reagent before introducing hydrogen peroxide, the reaction is caused by strong chemical oxidants or plant peroxidases already present in the sample. This immediate false positive renders the test result completely invalid for detecting blood.

17. (B) Hematin chloride crystals
The Teichmann test is a classic microcrystalline assay used for confirming the presence of blood in forensic evidence. Heating dried blood with glacial acetic acid and sodium chloride converts hemoglobin into hemin, forming characteristic dark brown, rhombic-shaped hematin chloride crystals. Microscopic visualization of these specific crystalline structures establishes a positive confirmatory identification for the presence of bloodstain material.

Click Here to Buy book on Amazon

complex. In the Starch-Iodine test, alpha-amylase present in a saliva extract cleaves the internal alpha-1,4-glycosidic bonds of starch, degrading it into shorter maltose and glucose fragments. These smaller carbohydrates cannot bind iodine, preventing blue-black complex formation and leaving the clear test zone unchanged.

54. (D) High levels of alpha-amylase
The Phadebas test is a quantitative and qualitative chromogenic assay used to detect alpha-amylase activity in biological evidence. The reagent contains water-insoluble starch polymer cross-linked with a blue dye. When alpha-amylase hydrolyzes the starch matrix, soluble blue dye fragments are released into solution. The intensity of the resulting blue color corresponds directly to the level of alpha-amylase present.

55. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Prostatic acid phosphatase deposited in the female genital tract during coitus undergoes rapid degradation due to environmental exposure, vaginal pH, and physiological drainage mechanisms. As a result of this inherent chemical instability and active biological clearance, acid phosphatase enzyme activity rapidly declines in the post-coital vaginal cavity, typically falling below detectable analytical thresholds within forty-eight to seventy-two hours.

56. (C) Urea and Creatinine
Forensic identification of urine stains relies on detecting metabolic waste products excreted by the renal system in high concentrations. Urea, the primary nitrogenous byproduct of protein catabolism, and creatinine, a end product of muscle creatine metabolism, are concentrated by kidney nephrons into urine. Concurrently testing for elevated levels of both urea and creatinine provides primary evidence for urine presence.

57. (D) Picric acid
The Jaffe reaction is a classic colorimetric assay utilized in forensic laboratories to detect creatinine in suspected urine deposits. Under alkaline conditions, picric acid reacts directly with creatinine present in the sample extract. This chemical reaction forms a reddish-orange janovsky-type complex, providing a visual qualitative indicator for the presence of creatinine during forensic examinations of biological stains.

58. (A) Ammonia
The Urease assay for urine identification utilizes the catalytic activity of the enzyme urease to hydrolyze urea present in the stain extract. Urease cleaves urea into carbon dioxide and gaseous ammonia. The release of basic ammonia gas increases the pH of the test medium, which is detected by indicator paper or Nessler's reagent, confirming the presence of urea.

59. (B) Urobilinogen
The Edelman test is a chemical screening assay used in forensic serology to confirm the presence of fecal material on physical evidence. Fecal matter contains high amounts of urobilinogen, a metabolic breakdown product of bilirubin produced by intestinal bacterial flora. Urobilinogen reacts with zinc salts in the Edelman reagent to form a green fluorescent complex under ultraviolet light.

60. (D) I, II and III
Prostate-Specific Antigen (p30) is a monomeric glycoprotein produced by prostatic epithelial cells and secreted directly into seminal plasma. Because its production is independent of spermatogenesis, p30 is present in semen from both normospermic and azoospermic males. Modern forensic workflows detect p30 quickly using lateral-flow immunochromatographic membrane strip assays, making all three listed statements completely correct.

61. (A) It is present in other fluids like serum, sweat, and milk.
A primary limitation of alpha-amylase testing for saliva identification is the enzyme's lack of absolute tissue specificity. Although salivary glands produce high alpha-amylase concentrations, lower levels of alpha-amylase isoenzymes are naturally present in other biological secretions, including blood serum, perspiration, nasal mucus, and breast milk. This cross-reactivity prevents alpha-amylase detection from serving as definitive confirmatory proof of saliva.

62. (C) Squamous epithelial cells containing glycogen
Microscopic identification of vaginal fluid relies on observing large, nucleated squamous epithelial cells shed from the vaginal mucosa. Under the influence of estrogen, these vaginal epithelial cells synthesize and accumulate significant intracellular stores of glycogen. Detecting

NODIA

27. (B) It cross-reacts with blood of higher primates like chimpanzees.
The precipitin test relies on immunological recognition of human serum proteins by anti-human antibodies. Because non-human higher primates, such as chimpanzees, gorillas, and orangutans, share extensive evolutionary homology and protein structure similarities with humans, anti-human antiserum cross-reacts with their blood proteins. This structural similarity represents a known limitation when attempting to distinguish human blood from higher primate species.

28. (B) Immunoelectrophoresis
Immunoelectrophoresis combines electrophoretic separation of proteins with immunodiffusion. Protein antigens in a biological sample are first separated through an agarose gel under an electric field based on charge and size. Troughs cut parallel to the separation path are filled with antiserum, allowing antibodies and separated antigens to diffuse towards each other, forming distinct arc-shaped precipitin lines for human protein identification.

29. (A) Methemoglobin
As bloodstains dry and age upon exposure to ambient atmospheric oxygen and environmental factors, the ferrous iron within oxyhemoglobin undergoes spontaneous auto-oxidation to the ferric state. This oxidative process converts oxyhemoglobin into methemoglobin, which cannot reversibly bind oxygen. This chemical transformation produces a visible color shift in the aging bloodstain, changing from bright red to dark brown.

30. (A) P-4, Q-3, R-1, S-2
Forensic serological assays rely on specific chemical reactions and morphological features. The Teichmann test yields hematin chloride crystals, while the Takayama test forms pyridine hemochromogen crystals. Ouchterlony double diffusion generates an antigen-antibody precipitation line in gel media, and the Kastle-Meyer test produces a pink color change upon oxidation of phenolphthalin. These characteristics establish the exact matched analytical pairs.

31. (D) Absence of fibrinogen and presence of endometrial cells
Menstrual blood is distinguished from peripheral venous blood by specific physiological and histological characteristics. Local enzymatic activity by plasmin during menstruation rapidly degrades fibrinogen and blood clots, rendering menstrual blood largely incoagulable. Furthermore, microscopic examination reveals abundant endometrial stromal and epithelial cells shed from the uterine lining during menstruation, which are completely absent in peripheral venous bloodstains.

32. (B) Visual examination → Presumptive test → Confirmatory test → Species determination
Processing suspected crime scene bloodstains follows a strict logical workflow. First, physical location and morphology are documented during visual examination. A rapid presumptive test screens for peroxidase activity to indicate blood. Upon positive screening, a confirmatory microcrystalline assay proves hemoglobin presence. Finally, species identification tests determine whether the confirmed bloodstain originated from a human or non-human animal source.

33. (B) Ciliated columnar epithelial cells and mucus
Blood originating from a nasal hemorrhage passes through the respiratory tract lining, picking up characteristic anatomical elements. Microscopic examination of epistaxis bloodstains reveals ciliated pseudostratified columnar epithelial cells detached from the nasal mucosa alongside abundant respiratory mucin. These distinct cellular and secretory features differentiate nasal blood from peripheral circulatory blood or other localized physiological bleeding sources.

34. (D) It may contain skin or muscle fragments.
Traumatic mechanical injuries disrupt soft tissue architecture, causing peripheral vessel rupture accompanied by physical tissue fragmentation. As blood flows over torn skin, subcutaneous fat, and skeletal muscle during traumatic injury, it physically incorporates microscopic fragments of epidermal, dermal, or muscular tissue. Finding these cellular tissue debris in bloodstain evidence distinguishes traumatic injury hemorrhage from non-traumatic physiological discharges.

35. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
The anti-human globulin test enhances immunodiffusion sensitivity by using antiglobulin antibodies to bind human immunoglobulins attached to target antigens.

Downloaded from www.pdf.tube

Human immunoglobulins exhibit notable environmental stability, remaining detectable in aged or degraded bloodstains where intact serum proteins fail to form visible precipitin bands. Consequently, detecting these stable immunoglobulins provides a sensitive method for establishing human origin in degraded biological samples.

36. (C) Spermatozoa and seminal plasma
Human semen consists of cellular and acellular liquid fractions. The cellular component comprises mature spermatozoa produced by the testes through spermatogenesis. The acellular fraction, known as seminal plasma, is a complex fluid secretion produced by accessory sex glands, including the seminal vesicles, prostate gland, and bulbourethral glands, providing nutritional support and transport medium for sperm cells.

37. (A) Acid phosphatase
Prostatic acid phosphatase is an isoenzyme synthesized and secreted in exceptionally high amounts by the epithelial cells of the human prostate gland. Its concentration in human seminal fluid is hundreds of times higher than in any other normal human body fluid or tissue. Consequently, testing for elevated acid phosphatase activity provides the primary preliminary screening target for identifying semen stains.

38. (D) Intense purple
The standard colorimetric acid phosphatase test uses alpha-naphthyl phosphate and Brentamine Fast Blue B salt. Prostatic acid phosphatase cleaves the phosphate group from alpha-naphthyl phosphate, releasing free alpha-naphthol. Free alpha-naphthol immediately couples with Brentamine Fast Blue B salt to form an insoluble azo dye, producing an intense purple color that confirms rapid positive catalytic activity for seminal fluid.

39. (B) Florence test
The Florence test is a traditional microcrystalline assay used in forensic laboratories to test for semen. The Florence reagent, containing potassium iodide and iodine, reacts specifically with choline present in high concentrations in seminal plasma. This chemical reaction forms characteristic dark brown, rhombic, or needle-shaped choline periodide crystals, providing microcrystalline indication of seminal fluid in physical evidence.

40. (A) I and II
Menstrual blood lacks normal clotting capabilities due to high concentrations of plasminogen activators that break down fibrin, and it contains distinct endometrial tissue cells shed from the uterine wall. However, the Kastle-Meyer test only screens for peroxidase activity in heme, which is identical in both venous and menstrual blood. Therefore, statements I and II are correct, while III is incorrect.

41. (D) Spermine
The Barberio test is a classical microcrystalline technique utilized to indicate the presence of human seminal fluid. The reagent consists of a saturated picric acid solution that reacts specifically with spermine, a polyamine compound present in significant quantities in prostatic secretions. This reaction yields yellow, needle-shaped crystals of spermine picrate, serving as an indicator of seminal fluid in test samples.

42. (B) II, IV, I, III
The correct order for performing the Kastle-Meyer test begins with lightly rubbing a moistened cotton swab over the stain to sample biological residue. Next, Kastle-Meyer reagent is applied to ensure no immediate oxidants cause a false positive color change. Hydrogen peroxide is then added to initiate catalytic oxidation, and the analyst observes for a rapid pink color change indicating blood.

43. (B) Yellow needle crystals
During a positive Barberio microcrystalline test for seminal fluid, picric acid reagent reacts specifically with spermine present in prostatic secretions. This chemical interaction produces insoluble spermine picrate crystals. Under microscopic observation, these diagnostic crystalline structures present as distinctive yellow, elongated, needle-shaped or slender rhombic crystals, confirming the chemical presence of spermine in the extracted biological sample.

44. (B) Azoospermia
Azoospermia is a medical condition defined by the complete absence of spermatozoa in the ejaculate. Men with azoospermia produce

NODIA

normal volumes of seminal plasma secreted by the prostate gland and seminal vesicles, but testicular sperm production is absent or obstructed. Forensic identification of semen from azoospermic males relies on non-cellular biochemical markers like acid phosphatase and prostate-specific antigen.

45. (B) II and IV
Determining the species origin of a bloodstain requires immunological assays that identify species-specific serum proteins. Both Ouchterlony double diffusion and cross-over immunoelectrophoresis utilize targeted antiserums to form visible precipitin lines when human proteins are present. In contrast, measuring alpha-amylase activity screens for saliva, and human DNA sequencing is a genetic profiling step rather than a traditional serological species test.

46. (C) p30
Prostate-Specific Antigen is a monomeric glycoprotein synthesized by the epithelial cells of the human prostate gland and secreted into seminal fluid. In forensic serology, this protein is commonly designated as p30 because of its molecular weight of approximately thirty kilodaltons. Its presence serves as a highly specific confirmatory marker for human seminal plasma, independent of sperm count.

47. (D) Fast Red and picroindigocarmine
The Christmas Tree stain, or Kernechtrot-Picroindigocarmine stain, is a differential histology staining method used to identify spermatozoa in microscopic forensic smears. The stain consists of Nuclear Fast Red, which stains nuclear chromatin, and picroindigocarmine counterstain, which selectively stains cytoplasmic protein structures. This combination produces sharp color contrast between different anatomical regions of human sperm cells for optical identification.

48. (C) Red
When sexual assault evidence is stained using the Christmas Tree Stain method, Nuclear Fast Red selectively binds to dense nuclear chromatin within the sperm head, imparting an intense red or pinkish-red color. Meanwhile, the picroindigocarmine counterstain colors the acrosomal cap light pink and the midpiece and tail green, enabling clear microscopic differentiation of intact spermatozoa.

49. (B) It detects semen even in azoospermic cases.
The p30 (Prostate-Specific Antigen) test provides significant analytical value in forensic sexual assault investigations because p30 is secreted by the prostate gland into seminal plasma. Consequently, p30 remains present in high concentrations in seminal fluid regardless of sperm cell count, allowing reliable detection of semen even in samples from vasectomized or medical azoospermic individuals lacking spermatozoa.

50. (A) P-3, Q-4, R-1, S-2
Microcrystalline tests in forensic serology produce specific chemical derivatives with unique crystal structures. The Teichmann test yields hematin chloride crystals, the Florence test produces choline periodide crystals, the Barberio test forms spermine picrate crystals, and the Takayama test generates pyridine hemochromogen crystals. Matching each microcrystalline method with its corresponding reaction product establishes correct analytical identification for biological exhibits.

51. (A) Vaginal secretions and fungi
The Acid Phosphatase test is a screening assay for seminal fluid, but it is not completely specific to prostatic secretions. Acid phosphatase enzymes are naturally produced at lower levels by human vaginal epithelial tissue, as well as by various bacteria and fungi. Prolonged incubation times allow these non-prostatic acid phosphatase sources to hydrolyze the substrate, causing potential false positive reactions.

52. (C) Alpha-amylase
Forensic detection of suspected saliva stains relies on targeting alpha-amylase, a digestive enzyme produced in abundance by human salivary glands, primarily the parotid glands. Alpha-amylase cleaves alpha-1,4-glycosidic bonds in starch molecules to begin carbohydrate digestion. Because salivary fluid contains extremely high concentrations of alpha-amylase relative to other body fluids, it serves as the primary target for saliva screening assays.

53. (A) No blue-black complex is formed.
Iodine reacts with intact poly-glucose starch chains to yield a deep blue-black chemical

Click Here to Buy book on Flipkart

ANSWERS

1. (B) Plasma contains coagulation factors like fibrinogen, whereas serum does not.
Blood plasma is the liquid component of whole blood containing clotting factors such as fibrinogen. When blood clots naturally, these clotting factors are consumed in forming the insoluble fibrin meshwork. The remaining liquid portion after coagulation is serum, which lacks fibrinogen and other clotting proteins, distinguishing it structurally and compositionally from anti-coagulated plasma.

2. (D) Erythrocyte
Mature human erythrocytes lose their nucleus and cellular organelles during erythropoiesis to maximize intracellular space for housing hemoglobin molecules. This anatomical specialization enables high-capacity binding and transport of respiratory gases, primarily oxygen, from the lungs to systemic peripheral tissues. The absence of a nucleus also imparts a flexible biconcave disk structure, facilitating passage through narrow capillaries.

3. (A) Four globin chains and four heme groups containing iron
Human hemoglobin is a heterotetrameric metalloprotein complex consisting of four polypeptide globin chains, typically two alpha and two beta chains in adult hemoglobin. Each individual globin chain is non-covalently bound to a prosthetic heme moiety. Every heme group contains a central ferrous iron ion that reversibly binds one oxygen molecule, allowing one complete hemoglobin molecule to transport four oxygen molecules.

4. (C) Perfect or near-perfect circle
Bloodstain pattern analysis indicates that when a falling blood droplet impacts a smooth surface at a perpendicular angle of ninety degrees, the force of impact spreads symmetrically in all radial directions. Because the impact vector lacks horizontal kinetic energy components, the resulting parent bloodstain forms a circular shape with equal length and width dimensions, exhibiting minimal directional distortion.

5. (A) To enhance contrast of the stain against the substrate
Alternate light sources utilize specific narrow wavelengths of light coupled with selective barrier filters to illuminate potential biological evidence at crime scenes. Blood absorbs light heavily at visual and ultraviolet wavelengths, specifically around four hundred fifteen nanometers. This strong light absorption creates visual contrast by darkening the bloodstain relative to the background substrate, aiding in locating latent or washed bloodstains.

NODIA

6. (D) The peroxidase-like activity of the heme group
Presumptive blood tests rely on the intrinsic peroxidase-like catalytic activity exhibited by the heme component of hemoglobin molecules. In the presence of hydrogen peroxide, the iron atom within heme catalyzes the oxidation of reduced chemical indicators, such as phenolphthalein or leucomalachite green. This rapid catalytic reaction yields a visible color change, indicating the potential presence of blood in a sample.

7. (B) The reagent is a known strong carcinogen.
The benzidine test was historically widely applied as a catalytic color test for screening bloodstains in forensic investigations. However, occupational health evaluations identified benzidine as a potent human carcinogen associated with bladder cancer. Consequently, forensic laboratories replaced benzidine with safer chemical substitutes, such as phenolphthalein, leucomalachite green, and tetramethylbenzidine, to protect laboratory analysts from hazardous chemical exposure risks.

8. (C) Bright pink
The Kastle-Meyer test utilizes phenolphthalin, a reduced and colorless form of phenolphthalein indicator. When applied to a sample along with hydrogen peroxide, heme present in blood catalyzes the oxidation of phenolphthalin back to phenolphthalein. This rapid oxidation reaction alters the chemical structure of the molecule, resulting in a distinct bright pink color that signifies a positive presumptive result for blood.

these glycogen-rich squamous epithelial cells via specialized staining techniques serves as a key cellular indicator for identifying vaginal secretions in forensic evidence.

63. (D) Lugol's iodine
Lugol's iodine solution is applied in forensic microscopy to identify vaginal epithelial cells. Iodine reacts specifically with intracellular glycogen accumulated within mature vaginal squamous epithelial cells, turning the cell cytoplasm a distinctive dark mahogany brown color. This iodine-glycogen reaction allows forensic analysts to visually differentiate glycogenated vaginal cells from other non-glycogenated epithelial cell populations under microscopic evaluation.

64. (C) Pepsin
Forensic identification of vomitus or gastric contents on crime scene physical evidence relies on measuring strongly acidic pH levels alongside detecting pepsin. Pepsin is a principal digestive endopeptidase produced by gastric chief cells in the stomach mucosa to hydrolyze dietary proteins into peptides. Detecting active pepsin in a sample extract provides biochemical confirmation of gastric juice presence.

65. (B) Sweat
Perspiration contains unique biochemical components secreted by epidermal eccrine and apocrine glands. Dermicidin is a specific antimicrobial peptide produced exclusively by eccrine sweat glands and secreted onto the skin surface. High concentrations of dermicidin alongside elevated lactic acid levels in clothing stains provide strong biochemical evidence for identifying perspiration in forensic biological trace evidence examinations.

66. (D) By species-specific immunological assays
Differentiating human breast milk from non-human animal milk, such as bovine milk, requires species-specific analytical techniques. General chemical tests for lactose, fat, or milk proteins yield positive results for milk from both species. Utilizing species-specific immunological assays, such as immunodiffusion or ELISA targeting human-specific milk proteins like alpha-lactalbumin, provides definitive forensic differentiation of human breast milk.

NODIA

67. (A) mRNA (messenger RNA) profiling
Modern molecular serology utilizes messenger RNA profiling to identify body fluids based on gene expression specificity. Different human tissues and bodily fluids express distinct sets of cell-specific genes. By isolating total RNA and amplifying specific mRNA transcripts via reverse-transcription polymerase chain reaction, analysts can definitively identify blood, saliva, semen, vaginal secretions, or menstrual blood in forensic stains.

68. (C) RNA degrades much faster than DNA in the environment.
Messenger RNA profiling offers high tissue specificity for body fluid identification, but faces environmental limitations. Single-stranded RNA molecules are inherently less stable than double-stranded genomic DNA and suffer rapid hydrolytic and enzymatic degradation by ubiquitous environmental ribonucleases. This heightened susceptibility to degradation reduces the success rate of RNA analysis on aged, weathered, or severely compromised crime scene evidence.

69. (A) DNA methylation
Epigenetic body fluid identification assays analyze tissue-specific DNA methylation patterns across the genome. Cytosine residues at specific CpG dinucleotide sites exhibit differential methylation status depending on the cell type and tissue origin. By measuring precise DNA methylation levels at target genomic loci using bisulfite conversion or methylation-sensitive enzymes, forensic scientists can identify individual body fluids in biological evidence.

70. (A) P-2, Q-4, R-1, S-3
Forensic serology uses specific chemical and enzymatic markers to screen for biological fluids. Saliva is characterized by elevated alpha-amylase activity, urine is identified by renal waste products like creatinine, fecal matter is detected via urobilinogen, and seminal fluid is screened targeting high acid phosphatase concentration. Matching each biological material to its corresponding chemical marker establishes correct analytical pairing.

71. (B) Air-dry at room temperature away from sunlight.
Wet biological evidence, such as a bloodstained shirt, must be thoroughly air-dried at room

18. (D) Takayama test
The Takayama test, also known as the hemochromogen crystal test, is a reliable microcrystalline technique for confirming blood. The reagent contains pyridine, glucose, and sodium hydroxide, which react with heme upon mild heating. This reaction produces pink, needle-like or feathery crystals of pyridine hemochromogen, which are readily identifiable under light microscopy, confirming the presence of hemoglobin in bloodstains.

19. (A) It works better on older bloodstains and requires less heating.
The Takayama test offers distinct operational advantages over the Teichmann test in forensic laboratory analysis. It requires significantly gentler heating and effectively produces diagnostic pyridine hemochromogen crystals even on ancient, weathered, or severely heat-damaged bloodstains. This higher reliability and sensitivity on degraded biological samples make the Takayama test a preferred choice for confirmatory microcrystalline blood testing.

20. (A) I and II
The Kastle-Meyer test uses phenolphthalein to produce a bright pink color, and luminol emits chemiluminescence without requiring an alternate light source. However, presumptive tests are not conclusive proof of human blood because chemical oxidants, plant peroxidases, and non-human animal blood can also yield positive results. Therefore, statements I and II are correct, while statement III is inaccurate.

21. (A) Oxyhemoglobin
Spectrophotometric analysis of hemoglobin derivatives provides reliable identification of bloodstains based on characteristic light absorption spectra. Oxyhemoglobin, formed by the reversible binding of oxygen to ferrous heme, exhibits two distinct absorption bands located in the yellow-green region of the visible spectrum, known as the alpha and beta absorption bands, situated around five hundred seventy-seven and five hundred forty-one nanometers.

22. (D) Antigen-antibody reaction
The precipitin test relies on the specific immunological binding interaction between soluble protein antigens present in human serum and specific antibodies contained within antiserum. When anti-human antiserum encounters human serum proteins, immunocomplexes form and precipitate out of solution. This antigen-antibody reaction creates a visible precipitin line or band, providing definitive species origin determination in forensic serology analyses.

23. (B) A precipitin ring forms at the interface.
In the classic ring precipitin tube test, anti-human serum is layered beneath a liquid extract from a suspected human bloodstain. As the antiserum and sample extract diffuse towards each other at the liquid interface, human serum antigens bind to specific anti-human antibodies. This localized immunological cross-linking forms a distinct, insoluble white precipitate ring at the interface, confirming human origin.

24. (C) Rabbit
Rabbits are the primary animal host used to produce high-titer anti-human globulin serum for forensic serology assays. Human serum proteins are injected into rabbits, stimulating an immune response that produces polyclonal antibodies against human serum antigens. The harvested antiserum reacts specifically with human blood components, providing a reliable reagent for species identification through precipitin and immunodiffusion testing.

25. (B) II and III
Confirmatory tests for blood must conclusively establish the presence of hemoglobin or its chemical derivatives. The Teichmann test forms dark brown hematin chloride crystals, and the Takayama test produces pink pyridine hemochromogen crystals, making both techniques established microcrystalline confirmatory tests. In contrast, the Benzidine test is a preliminary color test, while immunoelectrophoresis is a species-origin assay for human proteins.

26. (A) Ouchterlony double diffusion
Ouchterlony double diffusion is a passive immunodiffusion technique performed in agarose gel medium. Antigens extracted from an unknown stain and antibodies from anti-human serum are placed into adjacent wells cut into the gel. Both reactants diffuse radially towards one another through the matrix, forming a visible line of precipitation where optimal stoichiometric concentrations of antigen and antibody interact.

Downloaded from www.pdf.tube

Therefore, statements I and III are correct, while statement II is false because subsequent DNA profiling remains fully achievable following serological screening.

81. (B) Absorption-Inhibition
Absorption-inhibition is a classical serological technique used to determine ABO blood groups from dried bloodstains. The bloodstain extract is incubated with antiserum containing known concentrations of A or B antibodies. Antigens in the stain absorb specific antibodies, reducing antiserum antibody titer. Adding indicator red blood cells reveals antibody neutralization, indirectly identifying the ABO antigens present in the stain.

82. (C) Acid Phosphatase test → Microscopic sperm search → DNA Extraction
Processing a vaginal swab follows a systematic workflow to preserve biological material. First, a rapid screening test for acid phosphatase activity is performed on a small extract to check for semen. If positive, microscopic examination of stained smears confirms spermatozoa presence. Finally, the remaining sample undergoes differential DNA extraction to separate female vaginal cells from male sperm cells for profiling.

83. (A) An interfering oxidant is present.
In the Kastle-Meyer test, phenolphthalin reagent is added to the sample before introducing hydrogen peroxide. The color change must occur only after adding hydrogen peroxide to demonstrate catalytic peroxidase activity. If the solution turns pink prior to adding hydrogen peroxide, an chemical oxidant or plant peroxidase present in the stain has directly oxidized the indicator, rendering the test result invalid.

84. (C) Zinc dust
Kastle-Meyer stock reagent is prepared by boiling phenolphthalein with potassium hydroxide in the presence of metallic zinc dust. Alkaline zinc acts as a reducing agent, transferring electrons to reduce phenolphthalein into its colorless, reduced form, phenolphthalin. This reduced reagent remains colorless in alkaline solution until catalytic oxidation by heme and hydrogen peroxide restores its pink phenolphthalein form during testing.

85. (B) II, III and IV
Serological evidence collection protocols mandate scraping dried bloodstains or swabbing surfaces, protecting exhibits from direct heat and sunlight, and packaging dry clothing in breathable paper containers to prevent degradation. Packing wet items directly into airtight plastic bags is incorrect because retained moisture promotes bacterial decay. Thus, statements II, III, and IV are correct practices, whereas statement I is incorrect.

86. (D) Lattes Crust method
The Lattes Crust method is a classical forensic serology technique designed to detect ABO agglutinins (antibodies) directly in dried blood crusts. Tiny fragments of the dried bloodstain are placed on glass slides and exposed to known indicator A, B, and O red blood cells. Microscopic observation of red cell agglutination around the crust identifies the anti-A or anti-B antibodies present.

87. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Reference blood samples drawn for forensic DNA and serological analysis are collected in purple-top tubes containing ethylenediaminetetraacetic acid (EDTA). EDTA functions as an effective anticoagulant and preservative by chelating divalent magnesium and calcium ions. Chelation inhibits metal-dependent nuclease enzymes that degrade genomic DNA, while simultaneously preventing coagulation cascades, making EDTA ideal for preserving reference blood specimens.

NODIA

88. (A) II, IV, III, I
Processing serological evidence in a forensic laboratory follows strict chain of custody and analytical protocols. Evidence parcels are first registered at the case acceptance section. Analysts then verify parcel seal integrity against specimen seal impressions. Next, evidence parcels are opened for preliminary and confirmatory serological testing. Finally, confirmed positive biological samples are forwarded to the DNA division for genetic profiling.

89. (A) I, II and III
Statutory regulations for gathering biological evidence from an accused require medical examinations to be conducted by registered medical practitioners upon police request. Valid consent or reasonable force authorized

(D) Assertion (A) is false but Reason (R) is true.

31. Which region of the mitochondrial genome is targeted for forensic DNA sequencing due to its high level of polymorphism?
(A) Mitochondrial cytochrome b gene region
(B) Mitochondrial 16S ribosomal RNA gene region
(C) Mitochondrial NADH dehydrogenase coding region
(D) D-loop control region HV1 and HV2

32. In mitochondrial DNA analysis, the term "heteroplasmy" refers to:
(A) Simultaneous presence of both nuclear and mitochondrial DNA within a single extracted sample
(B) A single-base point mutation that significantly alters the overall length of an STR repeat unit
(C) Co-existence of multiple distinct mitochondrial DNA sequence variants within one individual
(D) Complete failure of Taq polymerase during PCR amplification due to co-extracted enzyme inhibitors

33. A forensic team finds a cigarette butt at a crime scene. The biological material most likely to yield a DNA profile from the filter end is:
(A) Exfoliated hair follicle shaft fragments
(B) Saliva with buccal epithelial cells
(C) Acellular extracellular blood serum fluid
(D) Pure acellular sebaceous gland secretion

34. "Touch DNA" refers to DNA recovered from skin cells transferred to an object during brief contact. The primary challenge in analyzing Touch DNA is:
(A) The DNA is inherently different from blood DNA
(B) The rapid crystallization of skin cells
(C) It only contains mitochondrial DNA
(D) The low quantity of DNA recovered

35. Consider the following statements regarding Low Copy Number (LCN) DNA profiling:
I. It is generally used when the DNA template is less than 100-200 picograms.
II. It requires increasing the number of PCR cycles beyond the standard 28-30.
III. It is immune to issues like allele drop-out and drop-in.
Which combination is correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

36. When biological evidence is exposed to environmental factors like UV light, heat, or bacterial action, the DNA undergoes fragmentation. This is known as:
(A) Amplification
(B) Polymerization
(C) Degradation
(D) Hybridization

37. In the analysis of highly degraded DNA samples, "mini-STRs" are often utilized. How do mini-STRs improve amplification success?
(A) Re-positioning primers closer to repeats to yield smaller amplicons
(B) Re-designing primer targets to completely non-standard chromosomal regions
(C) Substituting standard dNTPs with chemically truncated nucleotide analogs
(D) Eliminating the initial cell lysis and DNA extraction phase entirely

38. A mixed DNA profile is commonly encountered in sexual assault evidence. The presence of a mixture is generally indicated by:
(A) Complete absence of signal peaks across all loci on the electropherogram
(B) Unusually high relative fluorescence intensity values for a single peak
(C) Total failure of sex-typing amelogenin marker amplicons to illuminate
(D) More than two distinct alleles detected across multiple STR loci

39. Differential extraction is a laboratory procedure specifically designed to:
(A) Differentially separate nuclear genomic DNA from mitochondrial DNA fractions
(B) Separate male sperm cell DNA from female epithelial cell DNA
(C) Rapidly isolate total cellular RNA molecules from double-stranded genomic DNA
(D) Selectively remove complex PCR enzymatic inhibitors found in soil samples

40. Match the term associated with DNA profiling artefacts (List I) with its characteristic (List II):
List I: (DNA profiling artefacts)
P. Stutter peak
Q. Allele drop-out

Click Here to Buy book on Amazon

CHAPTER 13
Basics of DNA Profiling

NODIA

1. Which of the following biological samples obtained at a crime scene will typically yield the highest quantity of nuclear DNA per cell?
(A) Mature red blood cells
(B) White blood cells
(C) Shed hair shafts without root
(D) Squamous epithelial cells in urine

2. In standard forensic practice, which cellular organelle provides DNA evidence that is strictly maternally inherited?
(A) Nucleus
(B) Ribosome
(C) Golgi apparatus
(D) Mitochondrion

3. The backbone of a DNA double helix is composed of alternating units of:
(A) Sugars and phosphates
(B) Purines and pyrimidines
(C) Amino acids and peptide bonds
(D) Nitrogenous bases and hydrogen bonds

4. According to Chargaff's rules of base pairing in double-stranded DNA, which of the following is always true?
(A) Adenine pairs with Guanine via two hydrogen bonds
(B) Cytosine pairs with Thymine via three hydrogen bonds
(C) Adenine pairs with Thymine via two hydrogen bonds
(D) Guanine pairs with Cytosine via two hydrogen bonds

5. A single nucleotide consists of three structural components. Which of the following is NOT one of them?
(A) An amino acid
(B) A nitrogenous base
(C) A five-carbon sugar
(D) A phosphate group

6. In human cells, nuclear DNA is organized into how many pairs of chromosomes?
(A) 22 pairs
(B) 23 pairs
(C) 46 pairs
(D) 24 pairs

7. Mitochondrial DNA (mtDNA) differs structurally from nuclear DNA because it is:
(A) Linear and single-stranded
(B) Circular and double-stranded
(C) Linear and double-stranded
(D) Circular and single-stranded

8. Which of the following represents the correct biological hierarchy from largest to smallest unit in genetic organization?
(A) Genome, Chromosome, Gene, Nucleotide
(B) Chromosome, Genome, Nucleotide, Gene
(C) Gene, Genome, Chromosome, Nucleotide
(D) Genome, Gene, Chromosome, Nucleotide

9. The non-coding regions of the human genome, which are highly polymorphic and commonly used for forensic DNA profiling, are colloquially referred to as:
(A) Exons
(B) Transcriptomes
(C) Ribosomal RNA
(D) Junk DNA

10. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Single Nucleotide Polymorphisms (SNPs) have lower discriminatory power per locus than Short Tandem Repeats (STRs).
Reason (R): SNPs are typically bi-allelic, whereas STRs are multi-allelic at each locus.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

11. Genetic polymorphism refers to the presence of two or more variant forms of a specific DNA sequence occurring in a population. To be considered a true polymorphism, the least common allele must have a frequency of at least:

(B) Hearsay evidence
(C) Confessions made to police officers
(D) Dying declarations

68. Arrange the following events in the history of DNA profiling from earliest to most recent:
I. Establishment of CODIS by the FBI
II. Discovery of the DNA double helix structure by Watson and Crick
III. First use of STR multiplex kits in forensics
IV. Invention of DNA fingerprinting by Alec Jeffreys
(A) II, IV, III, I
(B) II, IV, I, III
(C) IV, II, I, III
(D) II, I, IV, III

69. In forensic DNA profiling, a "non-coding region" refers to a section of DNA that:
(A) Does not encode functional protein sequences
(B) Cannot undergo enzymatic copying during PCR amplification cycles
(C) Lacks the standard structural sugar-phosphate molecular backbone
(D) Degrades completely and immediately upon cellular death events

70. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Degraded DNA samples often yield partial DNA profiles with missing larger STR loci.
Reason (R): Environmental factors fragment the DNA into smaller pieces, making it difficult to amplify longer STR target sequences.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

71. "Phenol-chloroform extraction" is an organic method used for DNA isolation. In this process, the DNA remains in the:
(A) Organic phase (bottom layer)
(B) Aqueous phase (top layer)
(C) Interphase (middle layer)
(D) Precipitate at the bottom of the tube

72. When analyzing a mixed DNA profile containing contributions from two individuals, the profile is often evaluated by separating the contributors into:
(A) Allelic peaks divided strictly into homozygous and heterozygous parts
(B) Loci separated individually into sex-typing amelogenin and STR loci
(C) Major and minor contributors based on signal peak heights
(D) Profile components separated into nuclear and mitochondrial lineages

73. A "stochastic effect" in forensic DNA amplification refers to:
(A) The predictable step-wise degradation of double-stranded DNA molecules
(B) The constant and steady rate of sequence mutation in mitochondrial DNA
(C) The non-specific mis-binding of PCR primers to non-target DNA regions
(D) Uneven allele amplification seen in low template copy number samples

74. Microvariant alleles at an STR locus occur when the repeat sequence is not a perfect multiple of the basic repeat unit. On an electropherogram, a microvariant allele like 9.3 at the TH01 locus indicates:
(A) 9 full repeats and 3 extra base pairs
(B) 9 full repeats and 3 extra complete repeat units
(C) 3 full repeats and 9 extra base pairs
(D) 9 repeats of a 3-base pair sequence

75. Consider the following statements regarding DNA evidence collection:
I. Wet bloodstains should be packaged in airtight plastic bags to prevent contamination.
II. Exhibits should be dried at room temperature away from direct sunlight before packaging.
III. Chain of custody must be documented from the crime scene to the laboratory.
Which combination is correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

76. A DNA "hit" occurs when a crime scene profile matches a profile in the national database. A "cold hit" specifically refers to:
(A) A database hit generated when comparing DNA profiles obtained from severely decomposed human remains

Downloaded from www.pdf.tube

(D) Completely eliminates any requirement for population statistical analysis

22. The CODIS (Combined DNA Index System) core loci were originally established by the FBI in 1997. How many core STR loci were included in this original set?
(A) 9
(B) 13
(C) 15
(D) 20

23. In a multiplex PCR reaction used for forensic STR typing, how are multiple loci amplified simultaneously?
(A) By running multiple separate thermal cycler instruments simultaneously
(B) By using multiplex primer sets tagged with distinct fluorescent dyes
(C) By sequentially adding specialized DNA polymerases during each cycle
(D) By utilizing locus-specific differential extraction protocols beforehand

24. The amelogenin gene is standardly included in forensic STR kits primarily for the purpose of:
(A) Determining the phenotypic eye colour of the donor
(B) Estimating the age of the donor
(C) Determining the biological sex of the DNA donor
(D) Identifying the racial origin of the donor

25. Consider the following statements regarding the Amelogenin locus:
I. The amelogenin gene is located on both the X and Y chromosomes.
II. The X chromosome amplicon is typically shorter than the Y chromosome amplicon.
III. A male profile shows two distinct peaks for Amelogenin.
IV. Amelogenin mutations can occasionally lead to false female profiles in males.
Which combination is incorrect?
(A) I and II only
(B) III and IV only
(C) None of the above (all statements are correct)
(D) II and IV only

26. Y-STR analysis is highly specific and uniquely useful in cases of:
(A) Sexual assault cases with female victims and male suspects
(B) Determining direct maternity relationships in complex civil disputes
(C) Identifying specific female contributors within complex mixed stains
(D) Tracing ancient maternal evolutionary lineages through mtDNA

27. A limitation of Y-STR profiling compared to autosomal STR profiling is that:
(A) It cannot be successfully performed on male body fluid evidence such as semen
(B) Male relatives in a paternal line share identical profiles absent mutations
(C) It fails to yield usable electropherogram peaks from male template DNA
(D) It requires substantially higher amounts of input template DNA for typing

28. Arrange the steps of conventional DNA profiling in the correct chronological order:
I. Capillary Electrophoresis
II. DNA Amplification (PCR)
III. DNA Extraction
IV. DNA Quantitation
(A) III, II, IV, I
(B) III, IV, II, I
(C) IV, III, II, I
(D) III, IV, I, II

NODIA

29. X-STR analysis is occasionally utilized in forensic casework. In which specific scenario is X-STR profiling most uniquely beneficial?
(A) Kinship cases testing whether two females share a biological father
(B) Identifying multiple individual male perpetrators in complex gang-rape cases
(C) Tracing direct patrilineal ancestral lines over many hundreds of years
(D) Mass disaster victim identification scenarios involving exclusively male remains

30. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Mitochondrial DNA (mtDNA) analysis is widely used for identifying old, highly degraded skeletal remains.
Reason (R): Mitochondrial DNA has a high copy number per cell compared to nuclear DNA.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.

by appropriate police officers governs the examination, and collected specimens must be legally sealed and transferred to the forensic laboratory. Police officers cannot independently extract blood without medical authority. Thus, statements I, II, and III are correct.

90. (A) P-3, Q-1, R-4, S-2
Early pioneers established foundational techniques in forensic serology. Paul Uhlenhuth developed the precipitin test for species identification, Karl Landsteiner discovered the human ABO blood group system, Leon Lattes created methods to determine blood groups from dried bloodstains, and Masao Takayama introduced the pyridine hemochromogen crystal test. Matching these scientists to their achievements establishes historical accuracy in forensic science.

www.nodia.in

Click Here to Buy book on Flipkart

R. Pull-up
S. Allele drop-in

List II: (Characteristics)

1. Failure of an allele to amplify due to low template
2. Minor peak typically one repeat unit shorter than the main allele
3. Sporadic appearance of an extra allele due to low-level contamination
4. False peak caused by spectral overlap of fluorescent dyes

(A) P-2, Q-1, R-4, S-3
(B) P-1, Q-2, R-3, S-4
(C) P-4, Q-3, R-2, S-1
(D) P-2, Q-4, R-1, S-3

41. In capillary electrophoresis, amplified DNA fragments are separated based primarily on their:
(A) Charge-to-mass ratio only
(B) Base sequence
(C) Methylation status
(D) Size (fragment length)

42. An electropherogram is the graphical output of DNA sequencing or STR analysis. The x-axis (horizontal) typically represents:
(A) Fragment size in base pairs
(B) Amount of fluorescence (RFU)
(C) Primer sequence
(D) DNA concentration in nanograms

43. On an STR electropherogram, if an individual is homozygous at a particular locus, the display will typically show:
(A) Two distinct alleles represented by peaks of approximately equal height
(B) One peak with roughly double expected heterozygous peak height
(C) Three distinct signal peaks clearly confirming a multi-contributor mixture
(D) Total absence of any observable signal peaks across the entire locus

44. Which process during the PCR amplification of STRs is primarily responsible for the creation of stutter peaks?
(A) Non-specific primer dimer formation during annealing
(B) Slipped strand mispairing by Taq polymerase enzyme
(C) Incomplete non-templated adenylation at the 3' end
(D) Exogenous DNA contamination of the reaction master mix

45. Consider the following statements regarding the interpretation of DNA results:
I. A match implies the evidence profile and the reference profile are identical at all tested loci.
II. An exclusion implies the evidence profile and the reference profile do not originate from the same source.
III. Inconclusive results occur when the profile quality is too poor to make a definitive call.
IV. A single locus mismatch is always immediately reported as an exclusion regardless of mutation considerations.

Which combination is incorrect?
(A) I and II only
(B) III and IV only
(C) IV only
(D) II and III only

46. The Random Match Probability (RMP) is a statistical calculation used to express:
(A) The exact statistical likelihood of a technician operational error during sample extraction
(B) The overall legal probability that the designated suspect committed the alleged offense
(C) Chance that an unrelated individual randomly chosen has a matching profile
(D) The estimated proportion of overall template DNA undergoing environmental degradation

47. If the allele frequencies for allele 'p' and allele 'q' at a specific STR locus in a population are known, the expected frequency of a heterozygote (pq) under Hardy-Weinberg equilibrium is calculated using the formula:
(A) p^2
(B) q^2
(C) $p + q$
(D) $2pq$

48. The Hardy-Weinberg principle relies on several assumptions. Which of the following is NOT an assumption of the Hardy-Weinberg equilibrium?
(A) Random mating within the population
(B) A large population size
(C) High mutation rate
(D) No migration or gene flow

49. The product rule is utilized in calculating the overall frequency of a multi-locus STR profile. The use of the product rule is statistically valid only if the loci are:
(A) Tightly located on the exact same physical

Downloaded from www.pdf.tube

(A) 0.1 percent
(B) 1 percent
(C) 5 percent
(D) 10 percent

12. Minisatellites or Variable Number of Tandem Repeats (VNTRs) typically consist of core repeat units of what length?
(A) 2 to 6 base pairs
(B) 10 to 100 base pairs
(C) 100 to 500 base pairs
(D) Over 1000 base pairs

13. Short Tandem Repeats (STRs), also known as microsatellites, are the standard markers in modern forensic DNA typing. What is their typical repeat unit length?
(A) 1 base pair
(B) 2 to 6 base pairs
(C) 10 to 100 base pairs
(D) 100 to 500 base pairs

14. Tetranucleotide repeats are preferred in forensic STR analysis primarily because they:
(A) Are the most abundant repeat type across the human genome
(B) Completely eliminate stutter peak artifacts during PCR amplification
(C) Balance high variability with lower PCR stutter artifacts
(D) Can be accurately resolved without capillary electrophoresis

15. Consider the following statements regarding Single Nucleotide Polymorphisms (SNPs):
I. They involve a variation of a single base pair.
II. They are less abundant in the human genome than STRs.
III. They are particularly useful for analyzing highly degraded DNA.
Which combination is correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

16. The fundamental principle of forensic DNA profiling is based on:
(A) Complete structural identity of functional coding DNA sequences across all individuals
(B) Natural variation in total chromosome numbers present among individual humans
(C) Length and sequence variations in specific non-coding DNA regions
(D) Unique individual amino acid sequences found in circulating plasma proteins

17. The technique of DNA fingerprinting using multi-locus probes was first developed in 1984 by:
(A) Kary Mullis
(B) Alec Jeffreys
(C) Colin Pitchfork
(D) James Watson

18. In the original RFLP (Restriction Fragment Length Polymorphism) method, what type of enzyme is used to cut the DNA into fragments?
(A) Thermostable DNA polymerase
(B) Standard DNA ligase enzyme
(C) RNA-dependent reverse transcriptase
(D) Restriction endonuclease

NODIA

19. The Southern blotting technique involves the transfer of DNA fragments from an electrophoresis gel to a:
(A) Nylon or nitrocellulose membrane
(B) Silanized high-density glass slide
(C) Cross-linked polyacrylamide gel matrix
(D) High-binding silica spin-column matrix

20. Match the milestone in DNA profiling (List I) with its key figure (List II):
List I: (Milestone in DNA profiling)
P. Discovery of DNA structure
Q. Invention of PCR
R. First use of DNA fingerprinting
S. Discovery of ABO blood groups
List II: (Key figure)
1. Alec Jeffreys
2. Karl Landsteiner
3. Kary Mullis
4. Watson and Crick
(A) P-4, Q-3, R-1, S-2
(B) P-3, Q-4, R-2, S-1
(C) P-4, Q-1, R-3, S-2
(D) P-1, Q-3, R-4, S-2

21. The transition from RFLP to PCR-based methods in forensic laboratories was primarily driven by the fact that PCR:
(A) Amplifies minute or partially degraded DNA samples
(B) Requires extensive quantities of high molecular weight DNA templates
(C) Directly sequences full human genome structures in a single operational step

(B) Combined DNA Identification Sequence
(C) Crime-scene Organized DNA Information System
(D) Computerized DNA Integration Software

59. The National DNA Data Bank in India, as proposed by various legislative bills, intends to establish indices. Which of the following is typically NOT a distinct index in such forensic databases?
(A) Crime scene index
(B) Economic status index
(C) Offender index
(D) Missing persons index

60. Match the DNA terminology (List I) with its definition (List II):
List I: (DNA Terminology)
P. Locus
Q. Allele
R. Genotype
S. Phenotype
List II: (Definitions)
1. The combination of alleles at a given locus
2. An alternative form of a gene or DNA sequence
3. The observable physical characteristic
4. The specific physical location of a gene on a chromosome
(A) P-4, Q-2, R-1, S-3
(B) P-2, Q-4, R-3, S-1
(C) P-4, Q-1, R-2, S-3
(D) P-1, Q-2, R-4, S-3

61. Which chemical reagent is commonly employed in forensic DNA extraction to break open cell membranes and denature proteins?
(A) Proteinase K
(B) Luminol
(C) Ninhydrin
(D) Sodium hypochlorite

62. In the context of DNA isolation, what is the role of Chelex 100 resin?
(A) To rapidly precipitate purified genomic DNA directly out of aqueous solution
(B) To emit distinct fluorescence under UV light when intercalated into double-stranded DNA
(C) To chelate divalent metal ions that activate DNA degrading enzymes
(D) To enzymatically synthesize complementary new DNA strands during extraction

63. Real-Time PCR (qPCR) is typically used in the forensic DNA workflow immediately before amplification. What is its primary purpose?
(A) To perform whole-genome sequencing of target organism DNA
(B) To size-separate fluorescently tagged amplicon fragments
(C) To covalently attach fluorescent dye labels to STR primers
(D) To quantify human-specific template DNA in a sample

64. A peak on an electropherogram is generally considered valid only if its height exceeds a certain threshold. This threshold is known as the:
(A) Maximum stutter ratio limit
(B) Homozygous signal barrier level
(C) Analytical threshold
(D) Taq polymerase activity limit

65. Consider the following statements regarding the DNA Technology (Use and Application) Regulation Bill in India:
I. It aims to regulate the use of DNA technology for establishing identity in criminal matters.
II. It proposes the establishment of a DNA Regulatory Board.
III. It mandates mandatory DNA profiling for all citizens of India.
IV. It includes provisions for protecting the privacy of DNA data.
Which combination is correct?
(A) I, II, and III
(B) II, III, and IV
(C) I, II, and IV
(D) I, III, and IV

66. The ethical and privacy concerns surrounding national DNA databases primarily revolve around:
(A) High annual financial expenditure required for maintaining secure database cloud servers
(B) Network bandwidth limitations affecting the speed at which profiles are uploaded
(C) The persistent inability of computerized DNA databases to solve historical cold cases
(D) Misuse of individual genetic profiles and personal privacy breaches

67. Under the Indian Evidence Act, DNA profiling evidence is generally admissible under the section pertaining to:
(A) Opinions of experts

Click Here to Buy book on Amazon

chromosome arm
(B) Inherited independently and in linkage equilibrium
(C) Structurally linked together on contiguous gene loci
(D) Sequenced exclusively from hypervariable mitochondrial regions

50. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): The Likelihood Ratio (LR) is widely preferred over Random Match Probability in evaluating mixed DNA profiles.
Reason (R): The Likelihood Ratio allows for the comparison of probabilities under two mutually exclusive hypotheses (e.g., prosecution vs. defense hypothesis).
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

51. In paternity testing, if a child possesses an allele at a particular STR locus that is not present in the mother and is also absent in the alleged father, this indicates:
(A) A genetic inconsistency (exclusion)
(B) A positive inclusion of paternity
(C) A failure of the amplification kit
(D) That the child is a chimera

52. Paternity Index (PI) is calculated for each locus evaluated. If the alleged father is genetically excluded at a locus (and assuming no mutation occurred), the PI for that locus is:
(A) 0
(B) 0.5
(C) 1
(D) 100

53. Standard paternity testing relies on analyzing nuclear DNA. To determine a maternal lineage (maternity) over several generations, which analysis is most appropriate?
(A) Mitochondrial DNA typing
(B) Lineage-based Y-chromosome STR analysis
(C) Single-locus X-chromosome STR profiling
(D) Sex-typing amelogenin gene loci analysis

54. During mass disaster victim identification (e.g., plane crash), secondary reference samples are often required when direct references (like a toothbrush) are unavailable. Which of the following constitutes an ideal secondary reference sample?
(A) Direct reference blood sample from the victim's non-biological spouse
(B) Known reference hair sample provided by the victim's adopted sibling
(C) Environmental swab collected from a public bench the victim sat on
(D) Direct buccal swab from the victim's biological parent

55. Consider the following statements regarding contamination in forensic DNA analysis:
I. Contamination can occur at the crime scene if first responders do not wear protective gear.
II. DNA contamination cannot occur during the laboratory extraction phase.
III. Laboratory personnel profiles are kept in an elimination database to detect in-house contamination.
Which combination is correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

56. What is the standard scientific unit used to express the quantity of DNA extracted from forensic samples?
(A) Macro-scale weight units like Milligrams (mg)
(B) Standard bulk metric units like Micrograms (μg)
(C) Trace biological mass units like Femtograms (fg)
(D) Nanograms (ng) or Picograms (pg)

57. The phenomenon of "allele drop-out" is most likely to occur in which of the following scenarios?
(A) When isolating high-molecular-weight DNA from pristine reference buccal swabs
(B) When utilizing an over-abundant concentration of high-quality template DNA
(C) When the capillary electrophoresis injection voltage drops significantly low
(D) When amplifying Low Copy Number (LCN) or degraded DNA

58. What does "CODIS" stand for in the context of forensic DNA databases?
(A) Combined DNA Index System

NODIA

(B) A hit matching a crime scene profile to an un-suspected database individual
(C) A match established exclusively through hypervariable region maternal mitochondrial DNA typing
(D) A profile match identified between two separate unknown crime victims involved in one case

77. The innocence project relies heavily on post-conviction DNA testing. This highlights the capacity of DNA evidence to:
(A) Exonerate wrongfully convicted individuals
(B) Conclusively prove deliberate malicious intent of perpetrators
(C) Precisely identify physical weapons used during crime commission
(D) Accurately estimate time of death during post-mortem exams

78. In terms of DNA admissibility under the Indian legal framework, who among the following is authorized to provide expert opinion on forensic DNA reports in a court of law?
(A) The assigned primary Investigating Police Officer handling case evidence
(B) The certified first responder attending and securing the crime scene
(C) A qualified Forensic Scientist in an FSL/ CFSL
(D) A licensed general medical practitioner giving forensic testimony

79. Capillary Electrophoresis uses which type of medium for the separation of DNA fragments?
(A) Submerged cross-linked agarose gel matrix block
(B) Vertical slab polyacrylamide gel matrix block
(C) Porous solid nitrocellulose blotting membrane
(D) Liquid polymer matrix inside a thin silica capillary

80. Match the forensic biological sample (List I) with the most appropriate DNA extraction challenge or feature (List II):
List I: (Forensic biological sample)
P. Semen stains (mixed with vaginal cells)
Q. Hair shaft
R. Bone/Skeletal remains
S. Touch DNA
List II: (Extraction challenge or feature)
1. Requires decalcification before extraction
2. Primarily yields mitochondrial DNA
3. Extremely low DNA quantity, prone to dropout
4. Requires differential extraction using DTT
(A) P-4, Q-2, R-1, S-3
(B) P-1, Q-3, R-2, S-4
(C) P-4, Q-1, R-3, S-2
(D) P-2, Q-4, R-1, S-3

81. To safely preserve DNA extracted in the forensic laboratory for long-term storage, it should ideally be kept at:
(A) Controlled ambient room temperature conditions
(B) Refrigerated liquid storage at 4 degrees Celsius
(C) -20 or -80 degrees Celsius
(D) Boiling water bath storage at 100 degrees Celsius

82. In DNA quantification, "human-specific" quantification is critical because:
(A) Non-human animal DNA produces significantly stronger fluorescence signal peaks than human DNA
(B) Total mass concentration of DNA must be mathematically converted into exact molarity values
(C) It completely separates non-nucleated red blood cells from nucleated white blood cell fractions
(D) Avoids amplifying co-extracted bacterial or fungal DNA

83. During PCR amplification, the denaturation step involves heating the sample to approximately 94-95°C. What is the molecular result of this step?
(A) Disruption of hydrogen bonds between bases
(B) Enzymatic cleavage of covalent phosphodiester backbone bonds
(C) Annealing of oligonucleotide primers to single-stranded target DNA
(D) Polymerase-mediated extension of synthesized complementary strands

84. In terms of genetic linkage, why are the STR loci chosen for standard forensic multiplex kits unlinked?
(A) To allow simultaneous multiplex PCR amplification inside a single tube
(B) To ensure all target loci maintain identical evolutionary mutation rates
(C) To enable application of product rule for frequency calculations

Downloaded from www.pdf.tube

(D) To ensure all amplicons selectively bind to a single fluorescent dye

85. A DNA profile generated from a scene demonstrates a partial match with a reference sample, exhibiting matches at only some loci and drop-out at others. This result is typically categorized as:
(A) Inconclusive or limited inclusion
(B) A definitive, unambiguous genetic exclusion of the reference source
(C) Conclusive proof of a close biological relative's direct involvement
(D) An isolated somatic or germline genetic mutation event at one locus

86. Familial DNA searching involves scanning a database for partial matches. What is its primary investigative purpose?
(A) To definitively identify non-paternity events in civil lineage disputes
(B) To accurately track migratory expansion patterns of ancient populations
(C) To isolate and detect minor DNA contributors within mixed biological stains
(D) To locate close biological relatives of unknown suspects

87. What is the fundamental ethical concern regarding the retention of DNA profiles of individuals acquitted of a crime?
(A) Rapid exhaustion of electronic cloud database server storage capacity
(B) Infringement on presumption of innocence and personal privacy
(C) Progressive physical degradation of digital profile data over extended time
(D) Operational disruption preventing familial search algorithms from running

88. Select the correct order of the three steps involved in a single PCR cycle:
(A) Annealing, Extension, Denaturation
(B) Denaturation, Extension, Annealing
(C) Denaturation, Annealing, Extension
(D) Extension, Denaturation, Annealing

89. Which enzyme is responsible for synthesizing new DNA strands during the extension phase of a PCR cycle?
(A) Restriction Endonuclease
(B) Ribonuclease
(C) DNA Ligase
(D) Taq Polymerase

90. In cases involving identical twins, standard forensic STR profiling:
(A) Cannot differentiate them due to identical nuclear DNA
(B) Can readily and unambiguously distinguish between individual siblings
(C) Demonstrates distinct sequence differences exclusively at amelogenin loci
(D) Is ruled automatically inadmissible across all legal court jurisdictions

www.nodia.in

NODIA

ANSWERS

1. (B) White blood cells
White blood cells contain functional cell nuclei loaded with nuclear DNA, whereas mature red blood cells lose their nuclei during maturation and lack nuclear genomic material entirely. Consequently, cellular blood fractions rich in leukocytes yield substantial quantities of nuclear DNA per cell. Skin epithelial cells and hair shaft fragments without roots yield significantly lower amounts.

2. (D) Mitochondrion
Mitochondria are cellular organelles located outside the nucleus that possess their own distinct genome. Mitochondrial DNA is transmitted exclusively through the maternal lineage, as sperm mitochondria are routinely degraded upon fertilization. In forensic investigations, mitochondrial DNA serves as a reliable marker for establishing maternal relationships and identifying severely degraded biological samples when nuclear DNA is degraded.

3. (A) Sugars and phosphates
The structural framework of a double-stranded DNA molecule consists of two elongated sugar-phosphate backbones running in opposite directions. Each backbone strand is formed by covalent phosphodiester bonds linking the deoxyribose sugar of one nucleotide to the phosphate group of the adjacent nucleotide. The nitrogenous bases project inward from this structural sugar-phosphate frame to form base pairs.

4. (C) Adenine pairs with Thymine via two hydrogen bonds
According to Chargaff's rules of base pairing, adenine always pairs specifically with thymine across complementary DNA strands through two hydrogen bonds. Conversely, guanine pairs with cytosine through three hydrogen bonds. This selective hydrogen bonding maintains the uniform double-helical structure of DNA and ensures precise molecular replication during cellular division and thermal amplification processes used in forensic laboratories.

5. (A) An amino acid
A nucleotide is the fundamental monomeric building block of nucleic acids, consisting of three distinct chemical components: a five-carbon sugar, a phosphate group, and a nitrogenous base. Amino acids are the monomeric sub-units that polymerize to form proteins, not nucleic acids. Therefore, amino acids are completely absent from the basic structural makeup of standard DNA and RNA molecules.

6. (B) 23 pairs
Human somatic cells normally contain 46 chromosomes in total, arranged as 23 distinct homologous pairs inside the nucleus. This karyotype comprises 22 pairs of autosomes and 1 pair of sex chromosomes, which determine biological sex as XX in females or XY in males. Forensic autosomal profiling targets non-coding short tandem repeats distributed across these 23 pairs of chromosomes.

7. (B) Circular and double-stranded
Human mitochondrial DNA exists as a small, closed circular, double-stranded genome containing approximately 16,569 base pairs. In contrast, nuclear DNA is organized into linear, double-stranded chromosomes. The compact circular structure of mitochondrial DNA, combined with its localization inside cellular organelles, provides enhanced resistance to environmental degradation compared to linear genomic DNA.

8. (A) Genome, Chromosome, Gene, Nucleotide
The organizational hierarchy of genetic material moves systematically from the entire set of genetic code down to individual building blocks. The genome represents the complete collection of genetic material in an organism. Chromosomes are large structures containing DNA within the genome, genes are specific functional segments located on chromosomes, and nucleotides are individual building blocks.

9. (D) Junk DNA
Non-coding regions of the human genome do not encode amino acid sequences for protein synthesis and were historically termed junk

Click Here to Buy book on Flipkart

Section 45 of the Indian Evidence Act, 1872 (now Section 39 of the Bharatiya Sakshya Adhiniyam, 2023). Forensic reports submitted by qualified forensic scientists provide specialized opinion on biological identification matters to assist judges in reaching sound legal decisions.

68. (B) II, IV, I, III
The historical timeline of DNA profiling began in 1953 with Watson and Crick's discovery of the double helix structure. In 1984, Sir Alec Jeffreys introduced DNA fingerprinting. The Federal Bureau of Investigation established CODIS in 1997. Subsequently, commercially available multiplex STR typing kits were introduced and widely adopted across forensic laboratories worldwide.

69. (A) Does not encode functional protein sequences
Non-coding regions of human DNA consist of sequence segments that do not contain code for directing protein synthesis. Because non-coding regions are exempt from natural selection pressures that constrain structural changes in functional genes, they accumulate high levels of polymorphic sequence and length variations, serving as superior markers for forensic personal identification.

70. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Degradation caused by heat, humidity, or nucleases physically cleaves long genomic DNA strands into short fragments. When degraded DNA undergoes PCR amplification, longer short tandem repeat target loci frequently fail to amplify because intact template strands spanning the target length are absent, leading to partial profiles exhibiting locus dropout at larger sizes.

71. (B) Aqueous phase (top layer)
Organic phenol-chloroform extraction isolates DNA by phase separation based on differential solubility. Phenol denatures proteins, which collect at the organic-aqueous interphase, while lipids dissolve in the lower organic phase. Hydrophilic DNA molecules remain selectively dissolved in the upper aqueous phase, which is subsequently aspirated for downstream ethanol precipitation and purification.

72. (C) Major and minor contributors based on signal peak heights
In forensic electropherogram interpretation of two-person DNA mixtures, relative peak heights measured in RFUs are evaluated across loci to separate mixture ratios. The contributor depositing the larger proportion of DNA yields consistently taller peaks designated as the major contributor, whereas the source contributing less DNA yields shorter peaks termed the minor contributor.

73. (D) Uneven allele amplification seen in low template copy number samples
Stochastic effects in PCR amplification occur when extremely low quantities of template DNA are present during early cycles. Random sampling variations lead to unequal binding of primers, causing unequal amplification of heterozygous alleles. This can manifest on electropherograms as severe peak height imbalance between alleles or total drop-out of one allele at a locus.

74. (A) 9 full repeats and 3 extra base pairs
Microvariant alleles represent short tandem repeat variants that contain incomplete repeat units alongside full core repeats. In standard allele nomenclature, a designation such as 9.3 at the TH01 locus denotes the presence of nine complete tetranucleotide repeat units plus a partial repeat containing three additional base pairs resulting from a sequence deletion or insertion.

75. (B) II and III only
Biological evidence must be thoroughly air-dried at room temperature away from direct heat and sunlight before packaging in breathable paper containers. Storing wet biological items in sealed plastic bags promotes moisture retention and fungal growth, accelerating DNA degradation. Proper documentation of the chain of custody from scene collection to laboratory testing ensures legal admissibility.

76. (B) A hit matching a crime scene profile to an un-suspected database individual
A cold hit occurs during automated database searching when an unsolved crime scene DNA profile generates a match against a profile belonging to a offender or suspect who was not previously linked to or suspected in that specific investigation, providing investigative leads

NODIA

19. (A) Nylon or nitrocellulose membrane
The Southern blotting procedure involves separating denatured single-stranded DNA fragments by gel electrophoresis, followed by transferring those fragments onto a solid support such as a nylon or nitrocellulose membrane. Once immobilized on the membrane, specific target sequences can be visualized by hybridizing labeled radio-isotope or chemiluminescent oligonucleotide probes to the target fragments.

20. (A) P-4, Q-3, R-1, S-2
James Watson and Francis Crick discovered the double-helical molecular structure of DNA. Kary Mullis invented the polymerase chain reaction technique for amplifying specific DNA sequences. Sir Alec Jeffreys pioneered forensic DNA fingerprinting using restriction fragment analysis. Karl Landsteiner discovered the human ABO blood group systems, establishing the foundation of forensic serology.

21. (A) Amplifies minute or partially degraded DNA samples
Polymerase chain reaction technology transformed forensic analysis because it can exponentially replicate trace quantities of highly degraded DNA into millions of copies. Older methods required un-degraded, high-molecular-weight DNA templates in substantial amounts, whereas enzymatic thermal cycling enables successful typing from minute, partially degraded biological evidence gathered directly from complex crime scenes.

22. (B) 13
In 1997, the Federal Bureau of Investigation formally selected 13 core short tandem repeat loci to establish the national framework for the Combined DNA Index System. These 13 loci provided extreme statistical power for profile discrimination. In 2017, the core panel was expanded to 20 loci to reduce casual profile matches and enhance international compatibility.

23. (B) By using multiplex primer sets tagged with distinct fluorescent dyes
Multiplex polymerase chain reaction allows multiple distinct DNA loci to be amplified simultaneously within a single reaction tube. This is accomplished by designing locus-specific primer pairs labeled with different fluorescent dyes and engineering unique amplification product size ranges, enabling laser detection systems to resolve overlapping loci during capillary gel electrophoresis analysis.

24. (C) Determining the biological sex of the DNA donor
The amelogenin gene is a widely utilized marker for biological sex determination in forensic DNA typing kits. It resides on both the X and Y sex chromosomes, but contains a characteristic six base pair deletion on the X chromosome relative to the Y chromosome, allowing convenient chromatographic or electrophoretic differentiation between female and male DNA sources.

25. (C) None of the above (all statements are correct)
The amelogenin gene resides on both sex chromosomes, with the X allele generating a 106 base pair amplicon and the Y allele generating a 112 base pair amplicon. Males display two peaks corresponding to X and Y, whereas females display a single X peak. Rare deletion mutations on the Y chromosome can yield false female profiles.

26. (A) Sexual assault cases with female victims and male suspects
Y-short tandem repeat analysis specifically targets short tandem repeat markers located exclusively on the male Y chromosome. This technique is especially valuable in investigating sexual assault cases where overwhelming amounts of female epithelial DNA mask trace quantities of male donor DNA, allowing targeted amplification of the male component without interference from background female biological material.

NODIA

27. (B) Male relatives in a paternal line share identical profiles absent mutations
Because the non-recombining portion of the human Y chromosome is passed intact from father to son, all male individuals within a direct paternal lineage share essentially identical Y-short tandem repeat haplotypes unless a germline mutation occurs. Consequently, Y-STR analysis cannot distinguish between biologically related paternal relatives such as brothers, fathers, or paternal uncles.

28. (B) III, IV, II, I
The standard workflow for forensic DNA typing follows a logical analytical sequence. First, DNA is isolated from biological stains through

genotypes (pq) occur at a frequency calculated as 2pq.

48. (C) High mutation rate
The Hardy-Weinberg equilibrium model relies on strict theoretical population assumptions: completely random mating, an infinitely large population size, absence of natural selection, no gene migration or gene flow, and negligible or absent mutation rates. A high mutation rate violates these underlying assumptions by continually altering allele frequencies over successive generations.

49. (B) Inherited independently and in linkage equilibrium
The product rule in statistical genetics combines individual locus allele frequencies by multiplying them together to calculate overall profile frequency. This mathematical multiplication is valid only when the evaluated loci are inherited independently of one another and exist in linkage equilibrium, meaning allele frequencies at one locus do not influence frequencies at another.

50. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Statistical evaluation of complex mixed DNA samples is widely conducted using Likelihood Ratios because they accommodate multiple potential contributors under competing hypotheses. By weighing the probability of observing the evidence under the prosecution hypothesis against the defense hypothesis, the Likelihood Ratio provides a robust, scientifically sound framework for evaluating complex, multi-person evidentiary mixtures.

51. (A) A genetic inconsistency (exclusion)
In standard parentage evaluation, a child must inherit one obligate allele at every locus from the biological mother and one obligate allele from the biological father. If a child possesses an allele that is absent in both the mother and the alleged father, it represents a genetic inconsistency, indicating non-paternity (exclusion) provided mutation is excluded.

52. (A) 0
The Paternity Index compares the probability that the alleged father transmitted the obligate paternal allele to the child against the probability that a random man from the population transmitted it. If the alleged father does not possess the child's obligate paternal allele, the numerator of this ratio becomes zero, making the Paternity Index 0.

53. (A) Mitochondrial DNA typing
Mitochondrial DNA is inherited maternally without undergoing genetic recombination during sexual reproduction. Consequently, mothers pass their exact mitochondrial DNA genome sequence to all offspring, both female and male. This unique maternal inheritance pattern makes mitochondrial DNA typing the ideal genetic tool for tracing direct maternal lineages across many successive generations.

54. (D) Direct buccal swab from the victim's biological parent
Secondary reference samples are collected from biological relatives when direct personal items of a missing individual or mass disaster victim are unavailable. A direct buccal swab taken from a known biological parent provides authentic nuclear DNA, enabling reliable pedigree matching through mendelian inheritance, whereas non-biological spouses, adopted siblings, or public surfaces fail to offer valid genetic links.

55. (C) I and III only
Foreign DNA contamination can occur both at the crime scene if first responders lack personal protective equipment and within the laboratory during sample handling and cellular extraction phases. To detect potential internal contamination, laboratories maintain staff elimination databases to cross-check operational profiles against evidentiary results during routine DNA quality assurance protocols.

56. (D) Nanograms (ng) or Picograms (pg)
Forensic samples typically yield minute quantities of extracted nuclear DNA. Standard laboratory protocols specify DNA concentrations and reaction target amounts using mass units such as nanograms or picograms. For instance, standard commercial short tandem repeat amplification kits optimized for forensic casework generally require approximately 0.5 to 1.0 nanogram of input human template DNA.

57. (D) When amplifying Low Copy Number (LCN) or degraded DNA
Allele drop-out is a stochastic failure where one or both alleles at a heterozygous locus fail to amplify to detectable levels. This phenomenon

Downloaded from www.pdf.tube

38. (D) More than two distinct alleles detected across multiple STR loci
Because human beings inherit one maternal and one paternal allele at each autosomal locus, an individual standard DNA profile exhibits a maximum of two alleles per locus. Finding three or more clear fluorescent signal peaks across multiple loci on an electropherogram demonstrates the presence of genetic material from more than one individual donor.

39. (B) Separate male sperm cell DNA from female epithelial cell DNA
Differential extraction exploits the structural resistance of sperm cell membranes, which are rich in disulfide cross-links, compared to standard female epithelial cells. A mild lysis buffer selectively lyses epithelial cells first, leaving sperm cells intact. Dithiothreitol is subsequently added to break sperm disulfide bonds, successfully isolating male donor DNA from female background DNA.

40. (A) P-2, Q-1, R-4, S-3
Stutter peaks are minor enzymatic artifacts typically one repeat unit shorter than the true allele. Allele drop-out represents the total non-amplification of an allele caused by low template amounts. Pull-up occurs due to spectral bleed-through between fluorescent dye channels. Allele drop-in involves sporadic amplification of minor contamination fragments in sensitive reactions.

41. (D) Size (fragment length)
In capillary electrophoresis, fluorescently tagged DNA molecules carry a uniform negative charge per unit mass due to their phosphate backbone structure. As they migrate through an uncrosslinked polymer matrix under an electric field, smaller DNA fragments encounter less friction and move faster than larger fragments, achieving separation strictly based on molecular length.

42. (A) Fragment size in base pairs
An electropherogram displays electrophoretic separation data obtained during capillary electrophoresis. The horizontal x-axis measures migration time converted into fragment size in base pairs by comparison against an internal lane size standard. The vertical y-axis measures relative fluorescence units, indicating the fluorescent signal intensity and relative quantity of amplified DNA present in the sample.

NODIA

43. (B) One peak with roughly double expected heterozygous peak height
When an individual is homozygous at a short tandem repeat locus, both maternal and paternal chromosomes contain identical repeat numbers. Consequently, during PCR amplification and capillary electrophoresis, amplicons of identical length co-migrate, resulting in a single fluorescent peak with roughly double the signal intensity or height of a typical heterozygous peak.

44. (B) Slipped strand mispairing by Taq polymerase enzyme
Stutter peaks are common amplification artifacts formed primarily when Taq polymerase undergoes slipped strand mispairing during primer extension across tandemly repeated sequence motifs. The template or newly synthesized strand temporarily slips by one repeat unit, creating minor secondary amplicons that are usually one repeat unit shorter than the primary allele peak.

45. (C) IV only
In forensic DNA interpretation, a match means profile identity at evaluated loci, exclusion indicates different sources, and inconclusive results stem from poor sample quality. A single locus mismatch is not automatically declared an exclusion without investigating potential germline mutation, primer binding site mutations, or technical artifacts that can alter individual alleles.

46. (C) Chance that an unrelated individual randomly chosen has a matching profile
Random Match Probability is a statistical measure that calculates the probability that a randomly chosen, unrelated individual from a specific population database will possess a DNA profile matching the evidentiary profile. It quantifies profile rarity across target populations without directly measuring legal guilt, lab operational errors, or environmental degradation levels.

47. (D) 2pq
Under the principles of Hardy-Weinberg equilibrium, the expected genotypic frequencies in a randomly mating population can be calculated from allele frequencies. For a locus with two alleles present at frequencies p and q, homozygous genotypes occur at frequencies p squared and q squared, whereas heterozygous

cellular extraction. Second, the extracted DNA is quantified to determine human template concentration. Third, target loci undergo multiplex enzymatic amplification via thermal cycling. Finally, amplified fragments are size-separated and detected using capillary gel electrophoresis.

29. (A) Kinship cases testing whether two females share a biological father
X-chromosome short tandem repeat markers exhibit unique patterns of inheritance because males pass their single X chromosome directly to all daughters, while females pass one of their two X chromosomes to each child. This makes X-STR profiling particularly powerful for resolving complex kinship questions, such as determining whether two females share a common biological father.

30. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Human cells contain hundreds to thousands of mitochondria, each housing multiple copies of mitochondrial DNA, whereas a somatic cell contains only two copies of nuclear genomic DNA. This extreme copy number difference explains why mitochondrial DNA persists and remains recoverable in old, highly degraded skeletal remains where nuclear DNA has completely degraded.

31. (D) D-loop control region HV1 and HV2
Forensic mitochondrial DNA sequencing focuses primarily on two hypervariable regions, designated HV1 and HV2, located within the non-coding displacement loop (D-loop) control region. These regions accumulate sequence mutations at a much higher rate than the coding regions of the mitochondrial genome, providing significant polymorphic variation for forensic comparison and identity testing.

32. (C) Co-existence of multiple distinct mitochondrial DNA sequence variants within one individual
Heteroplasmy refers to the presence of more than one distinct mitochondrial DNA sequence variant within a single cell, tissue type, or individual person. This genetic phenomenon can manifest as sequence differences between different tissues or as dual nucleotide peaks at a specific sequence site on an electropherogram, requiring careful consideration during mitochondrial analysis.

33. (B) Saliva with buccal epithelial cells
When a smoker holds a cigarette filter between their lips, saliva containing nucleated buccal epithelial cells is transferred onto the filter material. These shed epithelial cells provide high-quality genomic nuclear DNA, making cigarette butts excellent physical items of evidence for recovering full short tandem repeat DNA profiles during forensic criminal investigations.

34. (D) The low quantity of DNA recovered
Touch DNA samples are recovered from minute traces of epithelial cells deposited on handled items through casual physical contact. The fundamental challenge in interpreting touch DNA evidence stems from the low starting template mass, often falling below 100 picograms, which increases susceptibility to stochastic amplification phenomena like allele drop-out and contamination.

35. (A) I and II only
Low Copy Number DNA profiling is applied when input template DNA amounts fall below approximately 100 to 200 picograms. To generate readable electropherogram signals from such minute templates, laboratories increase the PCR cycle count beyond standard parameters. However, this increased sensitivity makes Low Copy Number typing particularly susceptible to stochastic effects, allele drop-out, and allele drop-in.

36. (C) Degradation
Environmental exposure to ultraviolet radiation, elevated heat, humidity, and microbial activity causes chemical breakdown of the sugar-phosphate DNA backbone, leading to strand cleavage and molecular fragmentation. This process is known as DNA degradation, which severely reduces the average molecular length of template DNA strands and hinders subsequent polymerase chain reaction amplification.

37. (A) Re-positioning primers closer to repeats to yield smaller amplicons
Mini-STR primer sets are redesigned to bind as close as possible to the core short tandem repeat sequence, thereby significantly shortening the overall size of the resulting amplicon. By producing smaller amplification products, mini-STR technology successfully amplifies severely degraded biological samples where large genomic strands have fragmented into short fragments.

Click Here to Buy book on Amazon

occurs predominantly when analyzing Low Copy Number samples or severely degraded DNA templates, where extremely low target molecule counts lead to unequal primer binding and preferential amplification during early PCR cycles.

58. (A) Combined DNA Index System
CODIS stands for Combined DNA Index System, an automated national DNA database software program maintained by the Federal Bureau of Investigation. It enables local, state, and federal law enforcement crime laboratories across the United States to store, cross-compare, and exchange forensic short tandem repeat profiles from convicted offenders, arrestee samples, and unsolved crime scenes.

59. (B) Economic status index
National forensic DNA databases organize stored profile records into functional indices based on sample origins, such as crime scene evidence indices, convicted offender indices, suspect indices, and missing persons indices. Personal socioeconomic data, including economic status or income levels, are completely irrelevant to criminal identification and are never categorized within forensic DNA database structures.

60. (A) P-4, Q-2, R-1, S-3
In genetics, a locus is the physical location of a sequence on a chromosome. An allele represents an alternative sequence variant at a locus. A genotype is the specific combination of alleles present at a locus in an individual. A phenotype represents observable physical or biological characteristics expressed by an organism.

61. (A) Proteinase K
Proteinase K is an endopeptidase enzyme widely utilized in forensic DNA extraction protocols. It functions by digesting nucleases and cellular structural proteins, effectively inactivating enzymes that might degrade DNA while breaking down nuclear and cytoplasmic membranes to release high molecular weight genomic DNA into aqueous extraction solution for subsequent laboratory purification.

62. (C) To chelate divalent metal ions that activate DNA degrading enzymes
Chelex 100 is an iminodiacetate chelating resin used in rapid forensic DNA extraction procedures. It binds polyvalent metal ions, particularly magnesium ions, which serve as essential cofactors for cellular DNase enzymes. By sequestering these divalent ions during high-temperature cell lysis, Chelex effectively protects purified single-stranded template DNA from severe enzymatic degradation.

63. (D) To quantify human-specific template DNA in a sample
Real-Time quantitative PCR is a critical quality control step in forensic analysis performed prior to short tandem repeat amplification. It determines the precise quantity of amplifiable human-specific genomic DNA present in an extract, preventing over-loading or under-loading of template DNA in subsequent multiplex PCR reactions and detecting potential PCR inhibitors.

64. (C) Analytical threshold
The analytical threshold is a laboratory-defined signal intensity level, measured in relative fluorescence units on an electropherogram, above which a peak can be reliably distinguished from instrument background noise. Peaks exceeding this threshold are confirmed as genuine amplified allele signals rather than baseline electronic background noise or non-specific technical fluctuations.

65. (C) I, II, and IV
The DNA Technology Regulation Bill in India was introduced to establish uniform standards for using DNA testing in legal and civil matters. It provides for establishing a DNA Regulatory Board and national DNA databanks while incorporating strict privacy protections. Crucially, the bill does not mandate universal profiling for all Indian citizens.

66. (D) Misuse of individual genetic profiles and personal privacy breaches
The collection and centralized storage of human DNA profiles in national law enforcement databases raise serious ethical and privacy concerns regarding unauthorized access, function creep, potential disclosure of sensitive medical or biological information, and potential infringement on constitutional individual rights to privacy and protection against unlawful personal self-incrimination during legal proceedings.

NODIA

67. (A) Opinions of experts
In Indian courts, forensic DNA profiling evidence is evaluated as expert scientific opinion under

DNA. Despite this historic designation, these non-coding regions harbor extreme sequence and length variability between individuals, making them extraordinarily valuable for personal identification, kinship analysis, and general forensic DNA testing applications.

10. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Single Nucleotide Polymorphisms typically exist in only two allelic variants at any single base position, making them bi-allelic markers. In contrast, Short Tandem Repeats feature variable numbers of repeated sequence units, producing multiple alleles at each locus. Consequently, individual Short Tandem Repeat loci provide substantially higher statistical discrimination than individual Single Nucleotide Polymorphism loci.

11. (B) 1 percent
In population genetics, a DNA sequence variant is formally classified as a genetic polymorphism if it occurs in a population at a frequency exceeding one percent. Sequence variations occurring at a frequency below one percent are generally classified as rare mutations rather than true genetic polymorphisms, as they do not persist stably in broader human populations.

12. (B) 10 to 100 base pairs
Minisatellites, also designated as Variable Number of Tandem Repeats, consist of repeating DNA sequences where each core repeat unit ranges in length from 10 to 100 base pairs. These loci exhibit extensive length variation across populations due to differences in the total count of repeated blocks, forming the foundation of early forensic restriction fragment analysis.

13. (B) 2 to 6 base pairs
Short Tandem Repeats, frequently termed microsatellites, are non-coding regions composed of repeating nucleotide sequences with core unit lengths ranging from 2 to 6 base pairs. Due to their small size, these markers are readily amplified through thermal amplification techniques even when extracted biological evidence exhibits moderate levels of environmental degradation.

14. (C) Balance high variability with lower PCR stutter artifacts
Tetranucleotide repeat markers, containing four base pair repeat units, are widely selected in forensic genetic panels because they strike an optimal balance between polymorphic sequence variation and operational stability. They generate significantly lower rates of enzymatic stutter artifacts during polymerase amplification compared to dinucleotide or trinucleotide repeats, simplifying complex electropherogram interpretation.

15. (C) I and III only
Single Nucleotide Polymorphisms represent single base pair alterations in DNA sequences and are extremely abundant across the human genome, far outnumbering short tandem repeats. Because single base variations require extremely short target amplification fragments, they are exceptionally well suited for analyzing highly degraded, ancient, or compromised biological materials where long template strands cannot be recovered.

16. (C) Length and sequence variations in specific non-coding DNA regions
Forensic DNA profiling relies on evaluating localized length and sequence variations present within hypervariable, non-coding regions of human genomic DNA. While protein-coding sequences are highly conserved among human beings to maintain vital biological functions, non-coding regions accumulate high levels of polymorphic variation, providing distinct genetic signatures suitable for individual identification.

17. (B) Alec Jeffreys
In 1984, Sir Alec Jeffreys developed the original DNA fingerprinting method at the University of Leicester. His technique utilized multi-locus restriction fragment length polymorphism probes to detect hypervariable minisatellites, revolutionizing forensic science by demonstrating that individuals possess unique, identifiable DNA patterns that can be recovered from biological crime scene stains.

18. (D) Restriction endonuclease
In restriction fragment length polymorphism analysis, restriction endonucleases are bacterial enzymes that recognize specific sequence motifs within genomic DNA and cleave double-stranded molecules at designated sites. This enzymatic digestion produces fragments of varying lengths determined by the presence or absence of recognition sites and variable tandem repeat counts between cleavage sites.

Downloaded from www.pdf.tube

entirely independent of prior case suspect lists or witness accounts.

77. (A) Exonerate wrongfully convicted individuals
Post-conviction DNA testing utilizes modern high-sensitivity amplification methods to re-evaluate biological evidence recovered from historic crime scenes. By establishing that physical crime evidence originated from an unknown third party rather than the convicted individual, post-conviction DNA testing serves as a powerful scientific mechanism to exonerate wrongfully convicted persons and rectify judicial errors.

78. (C) A qualified Forensic Scientist in an FSL/ CFSL
In legal proceedings within India, expert opinion regarding forensic DNA profiling is admissible under expert testimony statutory provisions when provided by qualified forensic scientists working in accredited State or Central Forensic Science Laboratories. These experts possess specialized scientific training required to analyze genetic data, interpret complex electropherograms, and present findings in court.

79. (D) Liquid polymer matrix inside a thin silica capillary
Modern capillary electrophoresis systems employ narrow glass capillaries filled with a replaceable, uncrosslinked liquid polymer matrix as the separation medium. Under a high-voltage electrical current, denatured single-stranded DNA fragments migrate through this liquid polymer, achieving high-resolution separation based on molecular length prior to automated laser-induced fluorescence detection and computer signal analysis.

80. (A) P-4, Q-2, R-1, S-3
Mixed semen stains require differential extraction using Dithiothreitol to break sperm cell walls. Hair shafts lacking roots primarily yield mitochondrial DNA. Bone and skeletal remains require extensive decalcification to remove hydroxyapatite before DNA isolation. Touch DNA contains minute template quantities highly prone to stochastic allele drop-out during multiplex amplification reactions.

81. (C) -20 or -80 degrees Celsius
For long-term preservation of purified forensic DNA extracts, samples are stored at freezing temperatures of -20°C or -80°C. Sub-zero storage inhibits residual nuclease activity, minimizes hydrolytic cleavage, and prevents microbial proliferation, thereby protecting DNA molecules from chemical degradation and ensuring stability for potential future re-testing or formal court evidence re-analysis.

82. (D) Avoids amplifying co-extracted bacterial or fungal DNA
Human-specific DNA quantification is essential in forensic workflows because environmental evidence often contains mixed biological material, including abundant co-extracted bacterial, fungal, or animal DNA. Quantification targets specific human nuclear sequences, ensuring that only human template mass is measured so that PCR reactions receive optimal target input without interference from non-human DNA.

83. (A) Disruption of hydrogen bonds between bases
During the denaturation step of a polymerase chain reaction cycle, heating the reaction mixture to approximately 94-95°C thermally disrupts the hydrogen bonds holding complementary nitrogenous bases together. This thermal separation converts double-stranded DNA into single-stranded template strands without cleaving the strong covalent phosphodiester bonds forming the underlying molecular sugar-phosphate backbone structure.

NODIA

84. (C) To enable application of product rule for frequency calculations
Forensics panels incorporate short tandem repeat loci located either on different chromosomes or physically far apart on the same chromosome to guarantee genetic independence (linkage equilibrium). Genetic unlinking ensures that allele inheritance at one locus is statistically independent of another, validating the use of the mathematical product rule to calculate multi-locus profile frequencies.

85. (A) Inconclusive or limited inclusion
When an evidentiary DNA profile displays a partial match with a reference sample—matching at some loci while showing allele drop-out or lack of signal at others due to low template mass or degradation—the result cannot be stated as a definitive inclusion or exclusion. Such profiles are formally reported as inconclusive or limited inclusion.

(B) Fluid tissue
(C) Muscular tissue
(D) Connective tissue

10. The fundamental functional unit of nervous tissue that is specialised to transmit electrical impulses is the:
(A) Neuron
(B) Osteocyte
(C) Chondrocyte
(D) Erythrocyte

11. Which organ system comprises the skin, hair, nails, and sweat glands, and serves as the primary barrier preventing the entry of pathogens into the body?
(A) Endocrine organ system
(B) Integumentary system
(C) Lymphatic organ system
(D) Immune defense system

12. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Cartilage injuries to the ear or nose take a significantly longer time to heal compared to minor bone fractures.
Reason (R): Cartilage is essentially avascular and relies on diffusion for nutrient supply, whereas bone is highly vascularised.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

13. The human skeleton is divided into the axial and appendicular skeletons. Which of the following bones belongs to the axial skeleton?
(A) Sternum
(B) Scapula
(C) Clavicle
(D) Femur

14. What is the total number of bones typically found in the adult human skeleton?
(A) 206
(B) 213
(C) 270
(D) 300

15. Consider the following statements regarding the functions of the skeletal system:
I. It provides structural support for the entire body.
II. It stores essential minerals such as calcium and phosphorus.
III. It contains red bone marrow, the primary site for hematopoiesis (blood cell formation).
IV. It generates the body's primary basal metabolic heat.
Which combination of the above statements is correct?
(A) I, II, and III only
(B) I, III, and IV only
(C) II, III, and IV only
(D) I, II, III, and IV

16. In the human skull, the large opening at the base of the occipital bone through which the spinal cord connects to the brain is called the:
(A) Foramen ovale
(B) Jugular foramen
(C) Foramen magnum
(D) Mental foramen

17. Which of the following accurately represents the typical distribution of vertebrae in the adult human vertebral column from superior to inferior?
(A) 7 Cervical, 12 Thoracic, 5 Lumbar, 1 Sacrum (fused), 1 Coccyx (fused)
(B) 5 Cervical, 12 Thoracic, 7 Lumbar, 1 Sacrum (fused), 1 Coccyx (fused)
(C) 7 Cervical, 10 Thoracic, 5 Lumbar, 1 Sacrum (fused), 1 Coccyx (fused)
(D) 8 Cervical, 12 Thoracic, 5 Lumbar, 1 Sacrum (fused), 1 Coccyx (fused)

18. Select the correct superior-to-inferior order of the regions comprising the human vertebral column.
(A) Cervical, Thoracic, Lumbar, Sacral, Coccygeal
(B) Thoracic, Cervical, Lumbar, Coccygeal, Sacral
(C) Cervical, Lumbar, Thoracic, Sacral, Coccygeal
(D) Lumbar, Thoracic, Cervical, Coccygeal, Sacral

19. In the thoracic cage, "true ribs" are defined as those that:
(A) Attach directly to the sternum via their own costal cartilages.
(B) Do not attach to the sternum at all.
(C) Attach indirectly to the sternum through the cartilage of the rib above.
(D) Articulate only with the cervical vertebrae.

Click Here to Buy book on Flipkart

CHAPTER 14

Human Anatomy Basics

1. In standard anatomical position, which of the following best describes the orientation of the human body?
(A) The body is upright, feet parallel, arms elevated, and palms facing inward toward the thighs.
(B) The body is upright, feet parallel, arms hanging at the sides, and palms facing forward.
(C) The body is supine, arms at the sides, and palms facing downward.
(D) The body is prone, feet slightly apart, and palms resting on the lateral aspect of the legs.

2. A body discovered at a crime scene has been severed into equal right and left halves. Which anatomical plane describes this division?
(A) Coronal plane
(B) Transverse plane
(C) Parasagittal plane
(D) Midsagittal plane

3. In anatomical directional terms, the relationship of the elbow to the wrist is best described as:
(A) The elbow is proximal to the wrist.
(B) The elbow is distal to the wrist.
(C) The elbow is medial to the wrist.
(D) The elbow is lateral to the wrist.

4. During a post-mortem examination, a forensic pathologist notes an injury located closer to the midline of the body compared to the nipple. The correct directional term to describe this injury's position relative to the nipple is:
(A) Lateral
(B) Anterior
(C) Medial
(D) Posterior

5. Match the anatomical directional terms in List I with their correct definitions in List II.
List I: (Directional Terms)
P. Anterior
Q. Posterior
R. Superior
S. Inferior
List II: (Definitions)
1. Toward the lower part of the structure or body
2. Toward or at the front of the body
3. Toward or at the back of the body
4. Toward the head end or upper part of a structure
(A) P-2, Q-3, R-4, S-1
(B) P-3, Q-2, R-1, S-4
(C) P-4, Q-1, R-2, S-3
(D) P-2, Q-3, R-1, S-4

6. Which of the following represents the correct order of structural organisation in the human body from the simplest to the most complex?
(A) Cellular, Chemical, Tissue, Organ, Organ System, Organismal
(B) Chemical, Cellular, Tissue, Organ, Organ System, Organismal
(C) Tissue, Cellular, Organ, Chemical, Organ System, Organismal
(D) Chemical, Tissue, Cellular, Organ System, Organ, Organismal

7. In forensic DNA profiling, mitochondrial DNA (mtDNA) is often extracted from degraded biological evidence. Where is the mitochondrion located within the cellular structure?
(A) Exclusively within the nucleus
(B) Within the cytoplasm of the cell
(C) Embedded in the plasma membrane
(D) Attached to the extracellular matrix

8. The human body is composed of four primary tissue types. Which tissue type is responsible for covering body surfaces, lining body cavities, and forming glands?
(A) Connective tissue
(B) Muscle tissue
(C) Epithelial tissue
(D) Nervous tissue

9. Blood is considered a specialised form of which primary tissue type?
(A) Epithelial tissue

Downloaded from www.pdf.tube

86. (D) To locate close biological relatives of unknown suspects
Familial DNA searching involves screening law enforcement databases using specialized algorithms to identify partial profile matches that suggest a close biological relationship, such as parent-child or sibling, between an unknown crime scene donor and a offender profile in the database. This technique provides investigative leads to locate unknown suspects through their relatives.

87. (B) Infringement on presumption of innocence and personal privacy
Retaining genetic profiles of individuals who have been formally acquitted or discharged in court raises significant legal and ethical objections regarding civil liberties. Opponents argue that permanent state retention of genetic data from unconvicted individuals infringes upon personal privacy rights, compromises bodily autonomy, and directly undermines the fundamental legal presumption of innocence.

88. (C) Denaturation, Annealing, Extension
A single cycle of the polymerase chain reaction consists of three consecutive temperature-controlled steps. First, denaturation at high temperature (94-95°C) separates double-stranded DNA into single strands. Second, annealing at lower temperature (50-65°C) allows primers to bind to complementary targets. Third, extension at intermediate temperature (72°C) enables Taq polymerase to synthesize new strands.

89. (D) Taq Polymerase
Taq polymerase is a thermostable enzyme originally isolated from the thermophilic bacterium Thermus aquaticus. In polymerase chain reaction amplification, Taq polymerase synthesizes new complementary DNA strands during the extension phase by incorporating free deoxynucleotide triphosphates onto bound oligonucleotide primers at elevated operational temperatures around 72°C without undergoing destructive thermal denaturation.

90. (A) Cannot differentiate them due to identical nuclear DNA
Monozygotic or identical twins develop from a single fertilized egg that splits into two embryos, resulting in identical nuclear genomic DNA sequences across all standard short tandem repeat loci. Consequently, standard forensic nuclear STR profiling cannot distinguish between identical twins, requiring specialized approaches such as whole-genome sequencing to identify rare somatic mutations.

www.nodia.in

NODIA

20. The bone of the upper arm that articulates with the scapula proximally and the radius and ulna distally is the:
(A) Tibia
(B) Clavicle
(C) Humerus
(D) Fibula

21. How many carpal bones are present in a single human wrist?
(A) 5
(B) 7
(C) 8
(D) 14

22. Which is the longest, heaviest, and strongest bone in the human body, frequently used in forensic anthropology for stature estimation?
(A) Humerus
(B) Tibia
(C) Fibula
(D) Femur

23. The patella (kneecap) is an example of which type of bone, characteristically embedded within a tendon?
(A) Irregular bone
(B) Sesamoid bone
(C) Flat bone
(D) Short bone

24. Consider the following statements distinguishing the bones of the forearm:
I. The radius is located on the lateral (thumb) side of the forearm in anatomical position.
II. The ulna is longer than the radius and possesses the olecranon process at its proximal end.
III. The radius primarily forms the hinge joint of the elbow with the humerus, while the ulna does not.
Which combination of the statements is correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

25. The human os coxa (hip bone) is formed by the fusion of three distinct bones during development. Which of the following is NOT one of these three bones?
(A) Ilium
(B) Ischium
(C) Pubis
(D) Sacrum

26. In anatomical joint classification, freely movable joints such as the shoulder and knee are termed:
(A) Diarthroses
(B) Synarthroses
(C) Amphiarthroses
(D) Cartilaginous joints

27. The immovable joints that connect the flat bones of the cranial vault are known as:
(A) Symphyses
(B) Sutures
(C) Syndesmoses
(D) Gomphoses

28. In forensic osteology, the estimation of a sub-adult's age is most reliably determined by examining:
(A) The degree and extent of cranial suture closure
(B) The appearance and fusion of epiphyseal centres
(C) The absolute length and fusion of the sternum
(D) The width and size of the greater sciatic notch

29. The morphological changes that occur on the symphyseal face of the pubic bone (Suchey-Brooks method) are primarily used by forensic anthropologists to estimate which biological profile parameter?
(A) Age at death
(B) Biological sex
(C) Living stature
(D) Geographical ancestry

30. When determining the sex of an unknown skull, which of the following features strongly indicates a male cranium?
(A) A sharp and thin upper supraorbital margin
(B) A small, smooth, unpronounced mastoid process
(C) A prominent, heavy supraorbital ridge
(D) A smooth, vertical, rounded frontal bone (forehead)

31. The most reliable skeletal indicator of biological sex in adult human remains is the:
(A) Skull
(B) Long bones
(C) Sternum
(D) Pelvis

Click Here to Buy book on Amazon

Assertion (A): Livor mortis (post-mortem staining) presents as a purplish-red discolouration on the dependent parts of a dead body.
Reason (R): Following somatic death, blood settles in the toneless capillary beds of the skin strictly under the influence of gravity.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

53. In cases of suspected sexual assault, forensic biologists search for spermatozoa. Spermatogenesis occurs within which specific anatomical structures of the male reproductive system?
(A) Seminiferous tubules of the testes
(B) Epididymal duct network of the testes
(C) Secretory tissue of the prostate gland
(D) Muscular wall of the vas deferens

54. The female reproductive organ where a fertilised ovum typically implants and develops during pregnancy is the:
(A) Ovary
(B) Fallopian tube
(C) Vagina
(D) Uterus

55. The integumentary system consists of two primary layers. The avascular outer layer composed of stratified squamous epithelium is the:
(A) Dermis
(B) Epidermis
(C) Hypodermis
(D) Subcutaneous layer

56. Friction ridge skin, which bears the unique patterns used in forensic fingerprint identification, is located exclusively on the:
(A) Dorsal surfaces of the hands, wrists, feet, and ankles
(B) Anterior and posterior surfaces of the main body torso
(C) Palmar surfaces of hands and plantar surfaces of feet
(D) Scalp, facial regions, and external surface of the neck

57. In the anatomy of the eye, the light-sensitive innermost layer that contains photoreceptor cells (rods and cones) is the:
(A) Cornea
(B) Sclera
(C) Iris
(D) Retina

58. Consider the following post-mortem changes observed in the human eye:
I. Loss of corneal reflex.
II. Opacity (cloudiness) of the cornea.
III. Tache noire (a dark brown/black band across the exposed sclera).
Which combination of these changes occurs early following death if the eyelids remain open?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

59. The auditory ossicles (malleus, incus, and stapes) are the smallest bones in the human body. They are located within the:
(A) Outer ear
(B) Middle ear
(C) Inner ear
(D) Eustachian tube

60. In forensic pathology, injury to a "vital organ" implies a high probability of immediate or rapid death. Which of the following is classically considered the most critical trio of vital organs (the "tripod of life")?
(A) Liver, Kidneys, Spleen
(B) Brain, Heart, Lungs
(C) Stomach, Intestines, Pancreas
(D) Heart, Liver, Brain

61. A blunt force injury that merely scrapes off the superficial epithelial layer (epidermis) of the skin without penetrating the dermis is medically termed a/an:
(A) Abrasion
(B) Contusion
(C) Laceration
(D) Incision

62. Extravasation of blood into the subcutaneous tissues following blunt trauma, leaving the skin surface physically intact but discoloured, is defined as a:
(A) Open laceration
(B) Deep puncture wound

NODIA

41. Which of the following statements correctly distinguishes the anatomy of the human lungs?
(A) The right lung has two lobes, and the left lung has three lobes.
(B) Both lungs have three lobes.
(C) Both lungs have two lobes.
(D) The right lung has three lobes, and the left lung has two lobes.

42. The primary muscle of respiration that separates the thoracic cavity from the abdominal cavity is the:
(A) Diaphragm
(B) Intercostal muscle
(C) Rectus abdominis
(D) Pectoralis major

43. Consider the following autopsy findings related to the respiratory system in a suspected drowning case:
I. Voluminous, water-logged lungs (emphysema aquosum).
II. Fine, white, persistent froth in the trachea and bronchi.
III. Petechial haemorrhages beneath the pleura.
Which combination represents classic signs of antemortem drowning?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

44. In a forensic investigation, estimating the time of death based on gastric emptying requires knowledge of digestive anatomy. The average capacity of an adult human stomach is approximately:
(A) 500 to 750 ml
(B) 1.5 to 2 liters
(C) 4.0 to 5.0 liters
(D) 8.0 to 10.0 liters

45. Which of the following abdominal organs is primarily responsible for the metabolic biotransformation and detoxification of poisons and drugs in the human body?
(A) Liver
(B) Pancreas
(C) Spleen
(D) Gallbladder

46. The structural and functional unit of the human kidney, responsible for the filtration of blood and urine formation, is the:
(A) Neuron
(B) Alveolus
(C) Nephron
(D) Villus

47. Arrange the following anatomical structures in the correct sequence to trace the pathway of an ingested poison through the digestive tract.
1. Stomach
2. Esophagus
3. Small Intestine
4. Large Intestine
(A) 1-2-3-4
(B) 2-1-3-4
(C) 2-3-1-4
(D) 3-1-2-4

48. The Central Nervous System (CNS) is strictly defined anatomically as comprising the:
(A) Brain and cranial nerves
(B) Spinal cord and spinal nerves
(C) Brain and spinal cord
(D) Brain, spinal cord, and autonomic ganglia

49. A fatal blow to the back of the neck may cause death primarily due to damage to which part of the brainstem that controls vital autonomic functions like heart rate and respiration?
(A) Cerebral cortex
(B) Medulla oblongata
(C) Cerebellar hemisphere
(D) Thalamic nucleus

50. The protective connective tissue membranes covering the brain and spinal cord are called the meninges. The correct sequence of these layers from the outermost (closest to the skull) to the innermost is:
(A) Dura mater, Arachnoid mater, Pia mater
(B) Pia mater, Arachnoid mater, Dura mater
(C) Arachnoid mater, Dura mater, Pia mater
(D) Dura mater, Pia mater, Arachnoid mater

51. Which endocrine gland, situated in the sella turcica of the sphenoid bone, is often referred to as the "master gland" because it regulates the functions of numerous other endocrine glands?
(A) Pituitary gland
(B) Thyroid gland
(C) Suprarenal gland
(D) Parathyroid gland

52. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).

Downloaded from www.pdf.tube

32. Consider the following morphological characteristics:
I. A subpubic angle greater than 90 degrees (U-shaped).
II. A wide, shallow sciatic notch.
III. A heart-shaped pelvic inlet.
IV. A short, wide, and flat sacrum.
Which combination of traits is characteristic of a typical female pelvis?
(A) I, II, and IV only
(B) I, II, and III only
(C) II, III, and IV only
(D) I, III, and IV only

33. In the estimation of living stature from skeletal remains, formulae such as those developed by Karl Pearson or Trotter and Gleser require the measurement of:
(A) The circumference of the skull
(B) The maximum length of intact long bones
(C) The maximum width of the pelvis
(D) The total length of the vertebral column

34. Rigor mortis involves the post-mortem stiffening of the body's musculature. The underlying biochemical cause of rigor mortis is:
(A) The rapid synthesis and accumulation of lactic acid within the degenerating muscle fibers
(B) The post-mortem coagulation of intravascular blood within the deep muscle capillaries
(C) The freezing and crystallization of intramuscular fluids due to a rapid drop in temperature
(D) The depletion of cellular ATP preventing the detachment of myosin from actin filaments

35. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Stature estimation using the femur yields more accurate results than stature estimation using the humerus.
Reason (R): The femur contributes directly to the vertical height of an individual when standing, whereas the humerus does not.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

36. Which chamber of the human heart has the thickest muscular wall (myocardium) due to its role in pumping oxygenated blood to the entire systemic circulation?
(A) Right atrium
(B) Right ventricle
(C) Left ventricle
(D) Left atrium

37. In cases of homicidal cut-throat injuries, rapid and fatal haemorrhage typically occurs due to the severing of which major bilateral blood vessels located in the neck?
(A) Carotid arteries and jugular veins
(B) Subclavian arteries and subclavian veins
(C) Brachial arteries and deep brachial veins
(D) Femoral arteries and deep femoral veins

38. Histologically and anatomically, veins differ from arteries in that veins generally possess:
(A) Thicker muscular walls to withstand high blood pressure
(B) A brighter red appearance due to highly oxygenated blood
(C) A narrower lumen compared to an artery of similar size
(D) One-way valves to prevent the backflow of blood

39. Match the bones in List I with their respective body regions in List II.
List I: (Bones)
P. Maxilla
Q. Scapula
R. Phalanges
S. Calcaneus
List II: (Body Regions)
1. Heel of the foot
2. Upper jaw of the face
3. Shoulder girdle
4. Fingers and toes
(A) P-2, Q-3, R-4, S-1
(B) P-3, Q-2, R-1, S-4
(C) P-2, Q-4, R-3, S-1
(D) P-4, Q-3, R-2, S-1

40. In the human respiratory system, the trachea is kept continually patent (open) by the presence of:
(A) Continuous rings of vascular smooth muscle
(B) Thick bundles of elastic connective tissue fibers
(C) C-shaped rings of hyaline cartilage
(D) Overlapping plates of rigid interlocking bone

NODIA

(C) Contusion (Bruise)
(D) Heavy chop wound

63. A key anatomical feature that differentiates a laceration (caused by blunt force) from an incised wound (caused by a sharp edge) is the presence of:
(A) Clean, sharply divided and linear cutaneous wound margins
(B) An underlying linear cut or fracture in the target bone
(C) A wound length that is significantly greater than its depth
(D) Tissue bridging across the depth of the wound

64. A penetrating injury wherein the depth of the wound track in the body is greater than its length on the skin surface is classified as a:
(A) Laceration
(B) Incised wound
(C) Stab wound
(D) Graze abrasion

65. Select the sequence that represents the generally accepted chronological order of early post-mortem changes.
(A) Algor mortis, Primary flaccidity, Rigor mortis, Secondary flaccidity
(B) Primary flaccidity, Secondary flaccidity, Algor mortis, Rigor mortis
(C) Rigor mortis, Algor mortis, Primary flaccidity, Secondary flaccidity
(D) Algor mortis, Rigor mortis, Secondary flaccidity, Primary flaccidity

66. The forensic term "Algor mortis" specifically refers to:
(A) The gravitational settling of blood in dependent body parts
(B) The chemical post-mortem stiffening of the body musculature
(C) The cellular breakdown of tissues by endogenous digestive enzymes
(D) The post-mortem cooling of the body to ambient temperature

67. Under average climatic conditions, post-mortem lividity (livor mortis) typically begins to appear as patchy discolouration within:
(A) 5 to 10 minutes after death
(B) 1 to 3 hours after death
(C) 12 to 14 hours after death
(D) 24 to 36 hours after death

68. According to the "Rule of 12" regarding rigor mortis under average conditions:
(A) It appears in 2 hours, completes in 10 hours, and lasts for 12 hours.
(B) It takes 12 hours for primary flaccidity, 12 hours for rigor, and 12 hours for secondary flaccidity.
(C) It takes 12 hours to appear, lasts for 12 hours, and takes 12 hours to pass off completely.
(D) It develops fully in 12 hours and disappears immediately upon reaching 12 hours.

69. The most common primary incision used in standard forensic autopsies to open the thoracic and abdominal cavities is the:
(A) I-shaped midline incision from chin to symphysis pubis
(B) Y-shaped incision extending from behind each ear down to the symphysis pubis
(C) U-shaped incision extending across the chest between both anterior axillary lines
(D) Transverse incision extending horizontally across the lower abdominal wall

70. The autopsy technique where organs are removed and dissected as single en-bloc structural units rather than one-by-one is known as the:
(A) Virchow technique
(B) Rokitansky technique
(C) Ghon technique
(D) Letulle technique

71. Match the wound types in List I with their characteristic causative weapons/mechanisms in List II.
List I: (Wound Types)
P. Incised wound
Q. Chop wound
R. Laceration
S. Puncture wound
List II: (Causative Weapons/Mechanisms)
1. Heavy sharp-edged weapon (e.g., axe)
2. Sharp-cutting instrument (e.g., razor blade)
3. Pointed instrument (e.g., needle or ice pick)
4. Blunt force impact (e.g., iron rod)
(A) P-2, Q-1, R-4, S-3
(B) P-1, Q-2, R-3, S-4
(C) P-2, Q-4, R-1, S-3
(D) P-4, Q-1, R-2, S-3

72. During an autopsy in a suspected poisoning case, the entire contents of which organ must be carefully collected, measured, and preserved first to prevent contamination?

Click Here to Buy book on Flipkart

(A) Right lung
(B) Whole brain
(C) Stomach
(D) Whole spleen

73. According to standard forensic protocols, what minimum quantity of liver is typically collected and preserved for routine chemical analysis in poisoning cases?
(A) 50 grams
(B) 100 grams
(C) 500 grams or half the liver
(D) The entire liver must always be collected

74. The universal preservative solution used for visceral organs intended for chemical analysis (toxicology) is:
(A) Saturated Sodium Chloride solution or Rectified Spirit
(B) 10% Neutral Buffered Formalin aqueous solution prepared in phosphate buffer
(C) Deionized distilled water combined with alcohol stabilizers for tissue preservation
(D) 50% Glutaraldehyde solution formulated in standard physiological saline

75. In writing a medico-legal autopsy report, a medical officer describes a bullet wound as being "5 cm superior and 3 cm lateral to the umbilicus." This means the wound is located:
(A) Below and toward the midline from the navel
(B) Above and toward the side from the navel
(C) Below and toward the side from the navel
(D) Above and toward the midline from the navel

76. Consider the following classic anatomical and physical signs frequently observed at autopsy in cases of violent mechanical asphyxia (e.g., hanging or strangulation):
I. Cyanosis (bluish discolouration) of the face and lips.
II. Tardieu spots (petechial haemorrhages) under the conjunctiva and pleura.
III. Congestion and engorgement of the right side of the heart.
IV. Fluidity of the post-mortem blood.
Which combination accurately reflects these classical signs?
(A) I and II only
(B) I, II, and III only
(C) II, III, and IV only
(D) I, II, III, and IV

77. In the context of an exhumation, which anatomical structures are generally the most resilient and likely to be recovered intact after several years of burial in soil?
(A) Skeletal bones and teeth
(B) Kidneys, liver, and pancreas
(C) Lungs, trachea, and heart
(D) Brain, brainstem, and spinal cord

NODIA

78. Adipocere (saponification) is a late post-mortem change involving the conversion of body fats into a soapy, waxy substance. Which anatomical component of the body primarily undergoes this transformation?
(A) Skeletal muscle tissue matrix
(B) Red and yellow bone marrow
(C) Subcutaneous adipose tissue
(D) Soft tissue brain parenchyma

79. Mummification is a preservative post-mortem process that occurs naturally under specific environmental conditions. It primarily involves rapid:
(A) Hydrolysis and saponification of body tissues in a moist environment
(B) Bacterial decomposition and liquefaction of internal visceral organs
(C) Freezing and cryopreservation of body tissues at high altitudes
(D) Rapid dehydration and desiccation of body tissues

80. During the natural process of putrefaction, the order in which internal organs decompose varies. Anatomically, which is typically the FIRST internal organ to putrefy?
(A) Prostate (in males) or Uterus (in females)
(B) Heart
(C) Larynx and Trachea
(D) Kidneys

81. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Formalin must never be used as a preservative for viscera collected for toxicological analysis in suspected poisoning cases.
Reason (R): Formalin reacts chemically with many poisons (especially cyanides and alkaloids) and complicates the extraction process during chemical analysis.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true

but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

82. In an autopsy involving a suspected fatal road traffic accident where the driver was allegedly intoxicated, the best anatomical site to collect a blood sample for accurate post-mortem alcohol estimation is the:
(A) Thoracic cavity pool
(B) Abdominal cavity pool
(C) Left ventricle of the heart
(D) Femoral vein

83. The anatomical presence of diatoms deep within the marrow cavity of intact long bones (like the femur) during a post-mortem examination is a strong corroborative indicator of:
(A) Antemortem drowning
(B) Strangulation
(C) Post-mortem submersion of a dead body
(D) Poisoning by aquatic toxins

84. The hyoid bone, a U-shaped bone located in the anterior neck, is found fractured at autopsy most frequently in cases of:
(A) Judicial hanging performed using a standard long drop
(B) Accidental smothering with a soft fabric pillow
(C) Manual strangulation (throttling)
(D) Antemortem drowning in deep turbulent water

85. Consider the anatomical features typical of an exit wound caused by a rifled firearm projectile passing through the human body:
I. It is generally larger and more irregular than the entry wound.
II. It typically exhibits everted (outward-turning) margins.
III. It usually displays an abrasion collar and powder tattooing.
Which combination of statements correctly describes a standard exit wound?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

86. In examining a human skull to estimate age, a forensic expert notes that the sagittal suture is completely fused and obliterated both endocranially and ectocranially. This anatomical finding strongly suggests the individual was:
(A) A newborn infant or young child
(B) An adolescent between 5 and 10 years of age
(C) A young adult between 15 and 20 years of age
(D) An older adult

87. Arrange the biological stages of death in the correct anatomical and physiological sequence.
1. Somatic death (cessation of brain, heart, and lung function)
2. Cellular/Molecular death (death of individual cells and tissues)
3. Primary flaccidity (immediate muscular relaxation)
4. Onset of Rigor Mortis
(A) 1-3-2-4
(B) 1-2-3-4
(C) 3-1-4-2
(D) 1-3-4-2

88. Vitreous humor is frequently collected at autopsy because its anatomical isolation protects it from early putrefaction. The estimation of which specific ion in the vitreous humor is mathematically used to estimate the Time Since Death (PMI)?
(A) Calcium ions
(B) Sodium ions
(C) Potassium
(D) Chloride ions

89. Match the specific post-mortem change in List I with its underlying physiological mechanism in List II.
List I: (Post-Mortem Changes)
P. Algor mortis
Q. Livor mortis
R. Rigor mortis
S. Autolysis
List II: (Physiological Mechanisms)
1. Gravitational pooling of blood
2. Self-digestion by intracellular enzymes
3. Depletion of cellular ATP
4. Loss of metabolic heat production
(A) P-4, Q-1, R-3, S-2
(B) P-1, Q-4, R-2, S-3
(C) P-4, Q-3, R-1, S-2
(D) P-3, Q-1, R-4, S-2

90. In forensic pathology, the term "Corpus Delicti" literally translates to the "body of the crime." In

NODIA

and pronounced features compared to females. A prominent, heavy supraorbital ridge (brow ridge), along with large mastoid processes and rounded orbital margins, serves as a strong skeletal indicator of male biological sex.

31. (D) Pelvis
The human pelvis exhibits the highest degree of sexual dimorphism across the adult skeleton due to evolutionary adaptations for childbirth in females. Anthropological analysis of pelvic morphology, including subpubic angle and sciatic notch width, yields accuracy rates exceeding ninety-five percent, making the pelvis the single most reliable bone for sex estimation.

32. (A) I, II, and IV only
Female pelvic morphology is structurally specialized to facilitate childbirth, resulting in distinct anatomical differences from male pelves. Characteristics of a typical female pelvis include a wide subpubic angle greater than ninety degrees, a broad and shallow greater sciatic notch, a wide oval pelvic inlet, and a short, wide, flat sacral bone structure.

33. (B) The maximum length of intact long bones
Estimation of living stature in forensic anthropology relies on linear regression equations derived from biological populations. These mathematical formulae, including Karl Pearson's and Trotter-Gleser methods, require measuring the precise maximum physiological length of intact limb long bones, such as the femur, tibia, fibula, humerus, radius, and ulna, using an osteometric board.

34. (D) The depletion of cellular ATP preventing the detachment of myosin from actin filaments
Rigor mortis is a post-mortem physical stiffening of muscles caused by biochemical breakdown following death. Somatic death stops cellular respiration, depleting adenosine triphosphate (ATP) stores. Without ATP, cross-bridges formed between actin and myosin muscle filaments cannot detach, locking myofibrils in a stable state of muscular rigidity until enzymatic autolysis subsequently begins.

35. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
In stature reconstruction, lower limb long bones provide greater accuracy than upper limb bones. The femur forms a direct structural component of standing vertical body height. Consequently, femur length accounts for a major proportion of overall standing height, yielding significantly lower standard errors of estimate in forensic stature regression equations compared to humerus measurements.

36. (C) Left ventricle
The left ventricle of the human heart possesses the thickest muscular wall, approximately three times thicker than the right ventricle. This pronounced myocardial hypertrophy is an essential physiological adaptation, enabling the left ventricle to generate high systemic pressure required to pump oxygenated blood throughout the entire systemic vascular network of the human body.

37. (A) Carotid arteries and jugular veins
Deep cut-throat injuries involving the anterior neck frequently sever major bilateral vascular structures. The common carotid arteries supply oxygenated blood directly to the head and brain, while the internal and external jugular veins drain venous blood. Incising these large high-flow vessels produces massive external hemorrhage, rapid exsanguination, cerebral ischemia, and swift death.

38. (D) One-way valves to prevent the backflow of blood
Veins function as low-pressure conduits returning blood back toward the heart. Structurally, veins have thinner muscular tunica media walls and larger lumens than corresponding arteries. To overcome gravitational resistance during venous return, particularly in the lower extremities, small and medium-sized veins possess internal folds of endothelium forming one-way valves that prevent blood backflow.

39. (A) P-2, Q-3, R-4, S-1
Human skeletal anatomy pairs specific bones with distinct body regions. The maxilla forms the upper jaw of the facial skeleton. The scapula is the shoulder blade located in the pectoral shoulder girdle. Phalanges are the tubular bones forming the fingers and toes, while the calcaneus forms the prominent heel bone of the foot.

40. (C) C-shaped rings of hyaline cartilage
The trachea, or windpipe, is a flexible cartilaginous tube connecting the larynx to the primary bronchi. To maintain continuous airway patency

Downloaded from www.pdf.tube

ANSWERS

1. (B) The body is upright, feet parallel, arms hanging at the sides, and palms facing forward.
The standard anatomical position is a universal frame of reference used in human anatomy and forensic medicine. In this standardized posture, an individual stands completely upright with the feet positioned parallel and flat on the floor. The upper limbs hang vertically at the sides of the trunk, while the palms face directly forward.

2. (D) Midsagittal plane
Anatomical planes divide the human body into distinct sections for descriptive and forensic analysis. The midsagittal plane is a specific vertical plane passing vertically directly through the longitudinal midline. This precise orientation divides the entire body or a biological structure longitudinally into equal right and left halves, providing symmetrical structural reference points during anatomical investigations.

3. (A) The elbow is proximal to the wrist.
In human anatomy, directional terms precisely describe the positions of structures relative to one another along the limbs. The term proximal indicates that a structure lies closer to the origin of a limb or point of attachment to the trunk. Consequently, the elbow is positioned closer to the shoulder joint than the wrist, making it proximal.

4. (C) Medial
Anatomical directional terms describe the relative locations of anatomical features, lesions, or traumatic injuries across the human body. The term medial signifies an anatomical orientation located closer to or toward the median plane or central longitudinal line of the body. An injury situated nearer to this central axis than a lateral structure like the nipple is defined as medial.

5. (A) P-2, Q-3, R-4, S-1
Standard directional terms define spatial relationships in biological systems relative to anatomical axes. Anterior describes structures located toward or at the front of the body. Posterior denotes structures toward the back. Superior specifies locations toward the head end or upper body region, while inferior describes locations positioned toward the lower part or feet of a structure or body.

6. (B) Chemical, Cellular, Tissue, Organ, Organ System, Organismal
Structural organization in the human body follows a progressive hierarchical order of complexity. At the fundamental level, chemical elements form molecules. These molecules assemble into cellular structures, which combine to create specialized tissues. Tissues aggregate to construct organs, organs integrate into functioning organ systems, and all organ systems together form the complex living organism.

7. (B) Within the cytoplasm of the cell
Mitochondria are specialized double-membrane organelles located within the cytoplasm of eukaryotic cells. They act as the primary metabolic powerhouses by generating cellular energy through oxidative phosphorylation. Because mitochondria contain their own extranuclear circular DNA, their cytoplasmic location facilitates independent replication, enabling crucial forensic genetic recovery from degraded biological tissues lacking intact nuclear DNA.

8. (C) Epithelial tissue
Epithelial tissue is one of the four principal tissue types found in human histology. It forms continuous cellular sheets that cover external body surfaces, line internal organs and cavities, and form secretory structures called glands. Characterized by tightly packed cells with minimal extracellular matrix, epithelial tissues provide critical protection, absorption, filtration, and secretion functions.

9. (D) Connective tissue
Blood is biologically classified as a specialized fluid connective tissue. Like all connective tissues, blood develops embryonically from mesoderm and consists of living cellular components suspended within a nonliving extracellular liquid matrix known as plasma. It functions in oxygen transport, immune defense, nutrient delivery, and homeostasis throughout the entire systemic circulatory system of the human body.

NODIA

cases of homicidal violence, anatomical proof of the corpus delicti primarily requires:

(A) Discovery and identification of the body showing foul play

(B) Detailed written confession made voluntarily by the accused individual

(C) Successful recovery and forensic testing of the alleged murder weapon

(D) Direct eyewitness testimony describing the exact anatomical injury inflicted

www.nodia.in

Click Here to Buy book on Amazon

20. (C) Humerus
The humerus is the single long bone located within the upper arm region. Proximally, its rounded head articulates with the glenoid cavity of the scapula to construct the shoulder joint. Distally, the humerus features expanded condyles that articulate with the head of the radius and trochlear notch of the ulna at the elbow joint.

21. (C) 8
The human wrist, known anatomically as the carpus, comprises eight short bones arranged in two transverse rows of four bones each. The proximal row includes the scaphoid, lunate, triquetrum, and pisiform. The distal row consists of the trapezium, trapezoid, capitate, and hamate, which articulate with the metacarpals to provide flexible wrist mobility.

22. (D) Femur
The femur, located within the thigh, is the longest, heaviest, and strongest long bone in the human skeleton. Because its length exhibits a strong mathematical correlation with overall stature, the femur is extensively utilized in forensic anthropology and bioarchaeology to establish accurate regression formulae for estimating the living stature of unknown human remains.

23. (B) Sesamoid bone
Sesamoid bones are specialized nodular bones that form and develop inside tendons where significant physical strain, friction, and stress occur over joints. The patella, commonly known as the kneecap, is the largest sesamoid bone in the human body. Embedded within the quadriceps femoris tendon, it protects the knee joint and improves mechanical leverage.

24. (A) I and II only
In standard anatomical position, the radius is situated on the lateral thumb side of the forearm, while the medial ulna is longer and features the olecranon process proximally. Unlike the radius, the ulna forms the primary elbow hinge joint with the humerus. Thus, both radius orientation and ulna length represent accurate forearm characteristics.

25. (D) Sacrum
The os coxa, or hip bone, forms the lateral and anterior aspects of the pelvic girdle. During skeletal development, each os coxa is constructed from three distinct primary bones: the superior ilium, posterior ischium, and anterior pubis, which fuse at the acetabulum. The sacrum belongs to the axial skeleton and articulates directly with the ilium.

26. (A) Diarthroses
Functional classification of joints categorizes articulation points based on the degree of movement permitted between adjacent bones. Diarthroses are functional joints that are fully freely movable. Structurally classified as synovial joints, diarthroses feature a fluid-filled joint cavity encased by a fibrous capsule, enabling wide range of motion in limbs like shoulders and knees.

27. (B) Sutures
Sutures are rigid, fibrous joints found exclusively between the adjacent flat bones of the cranial vault in the skull. Bound tightly by thin layers of dense fibrous connective tissue, sutures function as synarthroses that permit virtually no movement, thereby providing maximum structural protection for the brain against mechanical trauma and impact forces.

NODIA

28. (B) The appearance and fusion of epiphyseal centres
In forensic osteology, estimating biological age at death for sub-adult skeletons relies on predictable developmental growth patterns. The appearance, ossification, and union of epiphyseal growth plates across long bones follow known chronological schedules. Assessing epiphyseal fusion stages provides the most precise and reliable indicator for determining age in infants, children, and adolescents.

29. (A) Age at death
The Suchey-Brooks method is a standardized anthropological technique used to estimate adult age at death from human skeletal remains. It relies on evaluating progressive morphological changes across the symphyseal face of the pubic bone, such as ridging, rim formation, and erosion, which reliably correlate with distinct chronological age phases across adult life.

30. (C) A prominent, heavy supraorbital ridge
Sexual dimorphism in the human cranium manifests through distinct morphological variations between biological sexes. Male skulls characteristically display more robust

10. (A) Neuron
The neuron is the basic structural and functional unit of nervous tissue. Specialized for high-speed communication, neurons process and transmit information throughout the central and peripheral nervous systems via electrochemical signals. Each neuron typically comprises a cell body containing the nucleus, multiple dendrites for receiving incoming signals, and a single axon for conducting action potentials.

11. (B) Integumentary system
The integumentary system is the largest organ system in the human body, encompassing the cutaneous membrane alongside accessory structures such as hair, nails, sebaceous glands, and sweat glands. It serves as a durable physical and chemical barrier protecting internal tissues against microbial pathogens, mechanical trauma, ultraviolet radiation, and excessive fluid loss while regulating temperature.

12. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Cartilage tissue lacks an intrinsic direct blood supply, making it essentially avascular. Consequently, nutrients and oxygen required for chondrocyte metabolism must slowly diffuse through the extracellular matrix from surrounding tissues. In contrast, osseous tissue is highly vascularized with a rich microvascular network. This vascular disparity explains why cartilaginous injuries require extended healing times compared to bones.

13. (A) Sternum
The human skeleton is organized into two primary division groups: axial and appendicular. The axial skeleton forms the central longitudinal axis of the body and comprises 80 bones, including the skull, hyoid bone, vertebral column, ribs, and sternum. In contrast, appendicular elements consist of upper and lower limb bones along with pectoral and pelvic girdles.

14. (A) 206
While human infants are born with approximately 270 individual cartilaginous and bony elements, growth and developmental maturation lead to the fusion of several skeletal structures over time. By adulthood, the typical human skeleton stabilizes at a total of 206 distinct bones, divided into 80 axial bones and 126 appendicular bones throughout the body framework.

15. (A) I, II, and III only
The skeletal system serves multiple crucial mechanical and physiological roles in the human body. It acts as a structural framework providing internal body support, protects delicate soft organs, stores vital mineral reserves including calcium and phosphorus, and houses red bone marrow responsible for hematopoiesis. Basal metabolic heat generation is primarily performed by skeletal muscle tissue.

16. (C) Foramen magnum
The foramen magnum is a large oval cranial aperture situated in the basilar portion of the occipital bone at the base of the skull. It serves as a vital transition passageway enabling the lower brainstem, specifically the medulla oblongata, to connect directly with the spinal cord, while accommodating vertebral arteries and spinal nerves.

17. (A) 7 Cervical, 12 Thoracic, 5 Lumbar, 1 Sacrum (fused), 1 Coccyx (fused)
The adult human vertebral column typically comprises 26 distinct osseous structures arranged in five regional segments from superior to inferior. These anatomical divisions consist of 7 cervical vertebrae supporting the neck, 12 thoracic vertebrae articulating with ribs, 5 lumbar vertebrae in the lower back, 1 fused sacrum formed by five segments, and 1 fused coccyx.

18. (A) Cervical, Thoracic, Lumbar, Sacral, Coccygeal
The human spine exhibits a defined craniocaudal structural alignment consisting of five successive anatomical regions from superior to inferior. Positioned at the top are cervical vertebrae in the neck region, followed by thoracic vertebrae in the chest, lumbar vertebrae in the lower back, fused sacral vertebrae, and finally the terminal coccygeal vertebrae forming the tailbone.

19. (A) Attach directly to the sternum via their own costal cartilages.
The thoracic cage in humans contains twelve paired ribs classified structurally by their anterior attachments. Rib pairs 1 through 7 are designated as true ribs or vertebrosternal ribs. Each true rib articulates posteriorly with a thoracic vertebra and extends anteriorly to connect directly to the sternum through its own individual bar of hyaline costal cartilage.

Downloaded from www.pdf.tube

during pressure changes during inhalation and exhalation, its anterior and lateral walls are supported by sixteen to twenty C-shaped rings composed of firm hyaline cartilage, completed posteriorly by smooth trachealis muscle.

41. (D) The right lung has three lobes, and the left lung has two lobes.
Anatomically, human lungs display asymmetrical lobar segmentation. The larger right lung is divided by deep oblique and horizontal fissures into three distinct lobes: superior, middle, and inferior. Conversely, the smaller left lung features only two lobes, superior and inferior, divided by an oblique fissure to accommodate the cardiac notch accommodating the heart.

42. (A) Diaphragm
The diaphragm is a broad, dome-shaped musculotendinous skeletal sheet separating the thoracic cavity from the abdominal cavity. Functioning as the principal primary muscle of inspiration, its contraction flattens the dome, increasing thoracic volume and decreasing intrathoracic pressure to pull air into the lungs, while relaxation permits passive expiration during normal human respiratory cycles.

43. (A) I and II only
In post-mortem examination of antemortem drowning, primary pathological signs involve characteristic respiratory tract changes. Inhaled fluid churned with mucosal secretions and surfactant creates a stable, persistent fine white froth within the trachea and bronchi. Hyper-expanded, water-logged voluminous lungs (emphysema aquosum) represent classic antemortem drowning signs, whereas subpleural petechiae are non-specific hypoxic indicators.

44. (B) 1.5 to 2 liters
The human stomach is a J-shaped muscular organ of the gastrointestinal tract located in the upper left abdominal quadrant. While its resting empty volume is approximately fifty milliliters, the physiological capacity of a fully distended adult stomach typically expands to accommodate roughly 1.5 to 2.0 liters of ingested food and liquid.

45. (A) Liver
The liver is the largest internal gland in the human body, situated in the right upper quadrant of the abdomen. It plays a central role in xenobiotic metabolism and clearance, using Cytochrome P450 enzyme systems to convert toxic substances, environmental poisons, and pharmaceutical drugs into water-soluble metabolites for biliary or renal excretion.

46. (C) Nephron
The nephron is the basic microscopic structural and functional unit of the human kidney. Each kidney contains approximately one million nephrons. A nephron comprises a renal corpuscle for blood plasma filtration and a specialized renal tubule system responsible for selective reabsorption, secretion, and urine formation before waste excretion from the body.

NODIA

47. (B) 2-1-3-4
Ingested materials follow a linear anatomical route through the gastrointestinal tract during digestion. Upon oral swallowing, food or ingested poisons pass down the esophagus, enter the stomach for mechanical and chemical breakdown, move into the small intestine for primary nutrient absorption, and finally proceed into the large intestine for water recovery.

48. (C) Brain and spinal cord
Anatomically, the nervous system is partitioned into central and peripheral components. The Central Nervous System (CNS) is strictly defined as comprising the brain, housed within the protective bony cranium, and the spinal cord, contained inside the vertebral canal. Peripheral, cranial, and autonomic nerves extending outside these structures form the peripheral nervous system.

49. (B) Medulla oblongata
The medulla oblongata forms the lowermost region of the brainstem, transitioning directly into the spinal cord near the foramen magnum. It contains vital autonomic centers that control cardiac output, vasomotion, swallowing, and involuntary respiration. Blunt traumatic impact or compression of the medulla oblongata quickly causes fatal cardiac arrest and respiratory failure.

50. (A) Dura mater, Arachnoid mater, Pia mater
The central nervous system is encased by three protective connective tissue membranous layers termed the meninges. Arranged in precise sequence from outermost to innermost relative to skull bones, they are the thick fibrous dura mater, the web-like vascular arachnoid mater,

together en bloc as a single continuous anatomical mass. This preservation of vascular and structural relationships allows comprehensive dissection and examination of organ continuity, particularly useful in vascular or surgical post-mortem pathology investigations.

71. (A) P-2, Q-1, R-4, S-3
Forensic wound classification directly links physical lesion characteristics to causative mechanisms. Incised wounds are produced by sharp cutting edges like razors. Chop wounds result from heavy sharp-edged weapons such as axes combining cutting and crushing. Lacerations stem from blunt force trauma like iron rods. Puncture wounds are caused by pointed slender tools like ice picks.

72. (C) Stomach
In suspected toxicological autopsies, the stomach and its complete unwashed contents must be collected immediately prior to dissecting other abdominal organs. Opening the stomach first inside a clean container prevents accidental loss of undigested pill fragments, toxic liquids, or volatile poisons while protecting surrounding abdominal tissues from cross-contamination during internal toxicological sampling.

73. (C) 500 grams or half the liver
The liver is the primary organ analyzed during forensic chemical analysis due to its extensive accumulation and metabolic detoxification of ingested drugs and poisons. Standard forensic pathology protocols dictate preserving a minimum quantity of 500 grams or roughly half of the liver to provide adequate tissue sample for toxicological extraction and quantitative analysis.

74. (A) Saturated Sodium Chloride solution or Rectified Spirit
To preserve visceral tissue samples for toxicological chemical analysis without destroying target toxic compounds, saturated sodium chloride solution or rectified spirit is universally utilized. Standard chemical fixatives like formalin must be avoided because aldehydes chemically react with organic poisons, such as cyanides and alkaloids, interfering with extraction and quantitative analytical laboratory results.

75. (B) Above and toward the side from the navel
Anatomical localization in formal medico-legal documentation relies on standard directional orientation terms relative to fixed anatomical landmarks like the umbilicus (navel). Superior denotes a position toward the head or above the landmark, whereas lateral specifies an orientation moving away from the midline toward the side, indicating an upper lateral wound location.

76. (D) I, II, III, and IV
Violent mechanical asphyxia severely impairs systemic oxygenation and venous return to the heart. Classical autopsy findings include facial cyanosis caused by unoxygenated hemoglobin buildup, subconjunctival Tardieu petechial hemorrhages from mechanical capillary rupture, acute right ventricular cardiac engorgement from increased pulmonary vascular resistance, and post-mortem blood fluidity due to rapid fibrinolysin release.

77. (A) Skeletal bones and teeth
During extended post-mortem soil burial, soft visceral organs rapidly undergo bacterial putrefaction, autolysis, and structural decay. In contrast, mineralized biological structures like skeletal bones and dental teeth possess high inorganic hydroxyapatite matrix content, rendering them exceptionally resistant to environmental decomposition, microbial breakdown, and soil acidity over prolonged spans of years.

78. (C) Subcutaneous adipose tissue
Adipocere formation, or saponification, is a modified post-mortem decomposition process that occurs in warm, moist, anaerobic environments. Endogenous lipolytic enzymes and anaerobic bacteria hydrolyze neutral body fats, converting subcutaneous adipose tissue into insoluble free fatty acids. These fatty acids react with environmental calcium and magnesium ions to form a waxy, soapy substance.

79. (D) Rapid dehydration and desiccation of body tissues
Mummification is a preservative post-mortem modification process occurring naturally in hot, dry, and well-ventilated environmental conditions. Rapid dehydration and evaporation of tissue moisture halt bacterial putrefaction and autolytic enzyme activity. As a result, the cutaneous and visceral body tissues undergo

Click Here to Buy book on Flipkart

61. (A) Abrasion
An abrasion is a superficial blunt force trauma injury produced by friction or scraping against a rough surface. This mechanical force removes or damages only the outer epidermal skin layer without breaching the underlying dermal basement membrane. Because the dermis remains intact, superficial abrasions heal without scarring and produce minimal capillary bleeding.

62. (C) Contusion (Bruise)
A contusion, or bruise, is a non-penetrating blunt force injury resulting from compressive impact that ruptures small subcutaneous capillaries and blood vessels. This vessel disruption causes extravasation of blood into surrounding subcutaneous interstitial tissues while leaving the overlying epidermal skin surface continuous and physically intact, resulting in characteristic localized cutaneous discolouration.

63. (D) Tissue bridging across the depth of the wound
Lacerations are tearing injuries caused by blunt force crushing or shearing forces that exceed tissue elasticity. A pathognomonic diagnostic feature distinguishing lacerations from sharp-force incised wounds is tissue bridging. In a laceration, stronger nerves, elastic fibers, and blood vessels resist shearing and remain intact across the depth between torn irregular wound margins.

64. (C) Stab wound
A stab wound is a sharp force injury produced by a pointed or sharp-edged instrument penetrating perpendicularly or obliquely into the body. Medico-legally, a stab wound is defined by its dimensional geometry, wherein the depth of the internal wound track significantly exceeds the length and width of the skin incision on the body surface.

65. (A) Algor mortis, Primary flaccidity, Rigor mortis, Secondary flaccidity
Following somatic death, post-mortem phenomena proceed in a chronological temporal sequence. Immediately after cardiac arrest, body cooling (algor mortis) initiates alongside loss of muscle tone (primary flaccidity). Chemical ATP depletion subsequently drives progressive muscular stiffening (rigor mortis). As putrefaction breaks down muscle proteins, rigor disappears into permanent muscular relaxation (secondary flaccidity).

66. (D) The post-mortem cooling of the body to ambient temperature
Algor mortis denotes the progressive physical cooling of a human corpse following somatic death. When cellular metabolic heat production ceases upon cardiac arrest, the dead body loses thermal energy via radiation, conduction, and convection. This cooling continues predictably until the body temperature reaches thermal equilibrium with the surrounding environmental ambient temperature.

67. (B) 1 to 3 hours after death
Livor mortis begins immediately after circulation stops, as stagnant blood settles in dependent capillary networks. Although microscopic hypostasis starts right after death, visible cutaneous mottling and patchy discolouration typically become detectable to the naked eye within 1 to 3 hours post-mortem, eventually coalescing into continuous patches over 6 to 8 hours.

68. (C) It takes 12 hours to appear, lasts for 12 hours, and takes 12 hours to pass off completely.
In forensic pathology, the mnemonic Rule of 12 provides a standardized baseline for estimating post-mortem interval from rigor mortis in temperate climates. Under average environmental conditions, rigor mortis takes approximately 12 hours to develop fully, persists steadily for 12 hours, and gradually dissipates over the subsequent 12 hours during secondary flaccidity.

69. (A) I-shaped midline incision from chin to symphysis pubis
The single straight vertical midline, or I-shaped, incision is the standard post-mortem primary incision used in forensic autopsies. Extending vertically from the symphysis menti of the chin down to the symphysis pubis, it provides optimal anatomical exposure of neck structures, thoracic organs, and abdominal viscera while minimizing cosmetic deformity during post-examination restoration.

70. (D) Letulle technique
The Letulle technique is a systematic autopsy evisceration method where cervical, thoracic, abdominal, and pelvic organs are removed

Downloaded from www.pdf.tube

and the delicate vascular pia mater adhering directly to the surface.

51. (A) Pituitary gland
The pituitary gland, or hypophysis, is a small pea-sized endocrine organ situated deep within the hypophyseal fossa of the sella turcica in the sphenoid bone. Commonly called the master gland, it secretes essential tropic hormones that directly control, balance, and regulate the physiological activity of other major endocrine glands across the human body.

52. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Livor mortis, or post-mortem hypostasis, is a physical post-mortem change characterized by reddish-purple discolouration of skin. Following cardiac arrest, blood circulation ceases entirely. Under gravitational influence, stagnant erythrocytes passively sink and collect within dilating capillary beds located in lower dependent regions of the body, leaving uncompressed non-dependent areas pale and unstained.

53. (A) Seminiferous tubules of the testes
Spermatogenesis is the complex biological process of male gamete production resulting in mature spermatozoa. This continuous developmental process occurs within the highly coiled seminiferous tubules located inside the lobules of the male testes. Sertoli cells within these specialized epithelial tubules provide essential nutrient support and regulation for developing germ cells in human males.

54. (D) Uterus
The uterus is a hollow, muscular, pear-shaped pelvic organ of the female reproductive system. Following fertilisation within the fallopian tube, the developing blastocyst travels into the uterine cavity and implants into the vascularized endometrial lining. The uterus provides physical protection, nutritional support, and structural expansion necessary for embryonic and fetal development.

55. (B) Epidermis
The integument consists of two distinct structural layers. The outer layer is the epidermis, composed of keratinized stratified squamous epithelium. Lacking direct blood vessels, the epidermis relies on passive diffusion of nutrients from underlying dermal capillaries. It forms a durable protective barrier against physical abrasion, environmental microbes, and excessive transepidermal water loss.

56. (C) Palmar surfaces of hands and plantar surfaces of feet
Friction ridge skin, or volar skin, is a specialized skin interface characterized by raised epidermal ridges and corresponding dermal papillae. Lacking hair follicles and sebaceous glands, friction ridge skin is found exclusively on the palmar surfaces of the hands and digits as well as the plantar surfaces of the feet and toes.

57. (D) Retina
The retina is the innermost, light-sensitive neural layer of the human eyeball. It contains specialized photoreceptor cells known as rods and cones, which convert light energy into electrochemical nerve impulses. These visual signals are subsequently transmitted via bipolar and ganglion cells through the optic nerve to the visual cortex for image processing.

58. (D) I, II, and III
Following somatic death, ocular changes develop rapidly, especially when the eyelids remain open. Loss of the corneal reflex occurs immediately upon brainstem death. Exposure leads to corneal drying and desiccation, causing corneal clouding within hours, while atmospheric exposure of scleral tissue creates a dark triangular band of discolouration termed tache noire.

59. (B) Middle ear
The auditory ossicles comprise three tiny connected bones: the malleus (hammer), incus (anvil), and stapes (stirrup). Housed within the air-filled tympanic cavity of the middle ear, these ossicles form a mechanical lever system that amplifies sound vibrations from the tympanic membrane and conducts them to the oval window of the inner ear.

60. (B) Brain, Heart, Lungs
In classical forensic pathology, the tripod of life refers to the three interconnected physiological systems essential for sustaining human existence: the nervous, circulatory, and respiratory systems. Represented anatomically by the brain, heart, and lungs, critical injury to any single member of this central organ trio induces rapid irreversible biological failure and somatic death.

NODIA

severe desiccation, transforming into dark, hard, leathery, and remarkably preserved structures.

80. (C) Larynx and Trachea
Internal organ putrefaction rates vary based on tissue moisture, blood supply, and bacterial load. Anatomically, soft vascular structures rich in mucous membranes and exposed to inhaled airborne bacteria decompose early. Consequently, the larynx and trachea are typically the first internal organs to undergo putrefactive liquefaction, whereas muscular organs like the uterus or prostate decompose last.

81. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Formalin solution is strictly prohibited as a preservative for visceral tissue samples intended for toxicological analysis. Formaldehyde chemically alters and cross-links organic compounds, reacting directly with cyanides, alkaloids, and phenolic poisons. This chemical alteration interferes with solvent extraction procedures, distorts chromatographic peaks, and prevents accurate analytical detection of targeted forensic poisons.

82. (D) Femoral vein
In post-mortem toxicological analysis, peripheral blood drawn from the femoral vein is the preferred biological sample for estimating ethanol concentration. Central cardiac blood and cavity pools suffer from post-mortem redistribution and diffusion of ethanol from the stomach. Femoral blood, isolated in peripheral vessels, provides accurate representation of antemortem systemic blood alcohol levels.

83. (A) Antemortem drowning
Diatoms are microscopic unicellular silica-walled algae present in aquatic environments. When a living individual drowns, inhaled water carries diatoms into alveolar capillaries, where active systemic circulation transports them into distant organs and bone marrow. Detecting diatoms inside closed femoral marrow cavities during post-mortem examination provides strong corroborative evidence of antemortem drowning.

84. (C) Manual strangulation (throttling)
The hyoid bone is a horseshoe-shaped structure located in the anterior neck superior to the thyroid cartilage. Fractures of the hyoid bone occur most frequently in cases of manual strangulation (throttling) due to direct, inward compressive force exerted on the neck by human hands, whereas hanging typically causes lesser hyoid fracture incidence.

85. (A) I and II only
Gunshot exit wounds are created as a bullet exits the body after traversing internal tissues. Characteristically, exit wounds are larger, more irregular, and display everted outward-pushed skin margins compared to entry wounds. Conversely, features like abrasion collars, soot deposition, and powder tattooing occur exclusively surrounding entry wounds rather than exit wounds.

86. (D) An older adult
Cranial suture closure follows a predictable chronological sequence useful for estimating adult skeletal age. The sagittal suture typically begins endocranial closure in early adulthood and completes full ectocranial synostosis with complete bony obliteration in older adults, usually beyond fifty years of age, indicating that the remains belong to an older adult individual.

87. (A) 1-3-2-4
Death occurs through sequential physiological stages. Somatic death initiates first with irreversible cessation of vital cardiac, respiratory, and brain functions. This is followed immediately by primary flaccidity, characterized by complete loss of muscle tone. Subsequently, progressive cellular death occurs as individual tissues die, while biochemical ATP depletion drives the onset of rigor mortis.

88. (C) Potassium
Vitreous humor is an isolated fluid within the posterior eye chamber, protected against early bacterial autolysis. Post-mortem, active cellular sodium-potassium pumps fail, allowing potassium ions to leak passively from retinal cells into the vitreous fluid at a steady rate. Measuring vitreous potassium concentration provides a reliable biochemical formula for calculating post-mortem interval.

89. (A) P-4, Q-1, R-3, S-2
Post-mortem physical and chemical changes correspond to specific physiological mechanisms. Algor mortis results from loss of metabolic heat production. Livor mortis stems from gravitational pooling of stagnant blood in

Click Here to Buy book on Amazon

33. Given below are two statements, one labelled as Assertion (A) and the other as Reason (R):
Assertion (A): In forensic serology, the absorption-elution method is generally preferred over the absorption-inhibition method for grouping small, dried bloodstains.
Reason (R): Absorption-elution is significantly more sensitive and can successfully group thread-sized stains that contain very minute quantities of antigen.
Select the correct answer from the options given below:
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

34. The mixed agglutination technique is an advanced serological method primarily adapted for identifying antigens on the surface of which types of samples?
(A) Freshly collected liquid blood sera and plasma samples
(B) Clear non-cellular bodily fluids like sweat, tears, and saliva
(C) Extracted nuclear DNA recovered from ancient skeletal remains
(D) Tissue cells, hair roots, and mucosal cells

35. When attempting to type older, environmentally degraded bloodstains, a common forensic complication that leads to false-positive ABO reactions is:
(A) Bacterial contamination producing A or B-like substances
(B) Rapid ambient evaporation of the liquid component of the stain
(C) Direct exposure to intense ultraviolet sunlight destroying antibody structures
(D) Complete biochemical conversion of functional hemoglobin to insoluble hematin

36. An individual who secretes water-soluble ABO blood group substances into their body fluids (like saliva, semen, and sweat) is genetically controlled by the Se gene. Which gene is the equivalent of the Se gene?
(A) FUT1
(B) FUT3
(C) FUT2
(D) RHCE

37. Approximately what percentage of the general population possesses the dominant 'Se' allele and are consequently classified as secretors?
(A) 20%
(B) 40%
(C) 60%
(D) 80%

38. Select the correct sequence of steps involved in the absorption-elution technique for grouping a dried bloodstain:
(A) Cleavage, Incubation with indicator cells, Washing, Addition of antiserum
(B) Addition of antiserum, Washing, Thermal elution, Addition of indicator cells
(C) Washing, Addition of indicator cells, Addition of antiserum, Thermal elution
(D) Thermal elution, Washing, Addition of antiserum, Addition of indicator cells

NODIA

39. To reliably detect the blood group of a suspect from a dried seminal stain found at a crime scene, the forensic serologist must first confirm that the suspect is:
(A) Rh positive
(B) A secretor
(C) Homozygous for the trait
(D) Not suffering from hemophilia

40. Match List I with List II and select the correct answer from the options given below:
List I: (Isoenzyme/Protein)
P. Phosphoglucomutase (PGM)
Q. Erythrocyte Acid Phosphatase (EAP)
R. Haptoglobin (Hp)
S. Glyoxalase I (GLO)
List II: (Relevance)
1. Highly polymorphic red cell enzyme useful in discriminating fresh bloodstains
2. Serum protein polymorphism previously used for paternal exclusion
3. Enzyme showing characteristic phenotypes dependent on the duration of storage
4. Enzyme associated with multiple alleles on chromosome 6
(A) P-1, Q-3, R-2, S-4
(B) P-2, Q-1, R-4, S-3
(C) P-1, Q-2, R-3, S-4
(D) P-3, Q-4, R-1, S-2

41. Group substances secreted into body fluids like saliva and semen by secretors are chemically classified as:
(A) Glycolipids

STUDYING FROM PDFs?

THINK AGAIN.

If you are studying only from PDFs,
you are wasting valuable time.

Research shows that learning from

PRINTED BOOKS has up to

4× HIGHER RETENTION

than studying from screens.

PRINT BOOK = BETTER MEMORY

PDF = LOWER RETENTION

Those who study from **PRINTED BOOKS**
move **AHEAD.**

Others are left **BEHIND**
in competition.

In competitive exams,
being average is not enough.

STAY ONE STEP AHEAD.

CHAPTER 15
Blood Grouping Systems

1. Who is credited with the discovery of the ABO blood group system in 1900?
(A) Leon Lattes
(B) Karl Landsteiner
(C) Alexander Wiener
(D) Edmond Locard

2. According to Landsteiner's Law, if a specific blood group antigen is present on the surface of an individual's red blood cells, what must be true regarding the corresponding antibody?
(A) The corresponding antibody will be present in their blood serum.
(B) The corresponding antibody will be found inside the red blood cells.
(C) The corresponding antibody will only appear after a blood transfusion.
(D) The corresponding antibody will be absent from their blood serum.

3. In the ABO blood group system, an individual with blood group AB possesses which of the following combinations?
(A) A and B antigens on red blood cells, and neither Anti-A nor Anti-B in serum.
(B) A and B antigens on red blood cells, and both Anti-A and Anti-B in serum.
(C) Neither A nor B antigens on red blood cells, and both Anti-A and Anti-B in serum.
(D) Only H antigen on red blood cells, and neither Anti-A nor Anti-B in serum.

4. The Bombay phenotype is a rare blood group identified by the complete absence of which specific antigen on the red blood cell surface?
(A) D antigen
(B) A antigen
(C) H antigen
(D) M antigen

5. In routine forward blood typing, an individual with the Bombay phenotype will falsely appear to belong to which blood group?
(A) Group O
(B) Group A
(C) Group B
(D) Group AB

6. Which plant seed extract (lectin) is routinely used in forensic serology to specifically differentiate the A1 subgroup from the A2 subgroup?
(A) Ulex europaeus
(B) Vicia faba
(C) Phaseolus vulgaris
(D) Dolichos biflorus

7. The inheritance of the ABO blood group system is governed by three multiple alleles. Where are these alleles located?
(A) Chromosome 6
(B) Chromosome 9
(C) Chromosome 11
(D) Chromosome X

8. If a child inherits an 'A' allele from the mother and an 'O' allele from the father, what will be the resulting blood group phenotype?
(A) Group O
(B) Group AO
(C) Group A
(D) Group AB

9. Which of the following immunoglobulins is the primary component of naturally occurring Anti-A and Anti-B antibodies in the ABO system?
(A) IgG
(B) IgA
(C) IgE
(D) IgM

10. What is the fundamental principle used to detect the presence of the H antigen on red blood cells?
(A) Agglutination with Ulex europaeus lectin
(B) Agglutination with Anti-D antisera
(C) Precipitation with Dolichos biflorus extract
(D) Hemolysis in the presence of complement

11. The Rh blood group system was discovered through experiments involving the red blood cells of which animal?
(A) Common guinea pig
(B) Rhesus monkey
(C) Wild chimpanzee

Downloaded from www.pdf.tube

dependent capillaries. Rigor mortis is caused by depletion of cellular ATP preventing muscle relaxation. Autolysis involves self-digestion of body tissues by endogenous lysosomal enzymes.

90. (A) Discovery and identification of the body showing foul play

In criminal jurisprudence and forensic pathology, corpus delicti refers to the essential facts establishing that a specific crime was actually committed. In homicidal investigations, establishing corpus delicti primarily requires discovering and identifying the deceased human body or remains, combined with medical evidence demonstrating that death resulted from unlawful lethal violence or foul play.

www.nodia.in

NODIA

glass surface within one or two minutes at room temperature?
(A) Gel card technique
(B) Slide method
(C) Tube method
(D) Microplate method

24. Consider the following statements regarding the advantages of the tube method over the slide method in serological testing:
I. It requires smaller quantities of reagents.
II. It allows for longer incubation periods without drying out.
III. It is less sensitive to weak antigen-antibody reactions.
IV. The reaction mixture can be gently centrifuged to enhance agglutination.
Which of the above statement(s) is/are correct?
(A) I, II and III only
(B) I, II and IV only
(C) II, III and IV only
(D) I, III and IV only

25. The principle of size exclusion, where a matrix traps agglutinated red blood cells at the top while allowing unagglutinated cells to pass to the bottom during centrifugation, is the basis of which modern grouping technique?
(A) Lattes crust method
(B) Absorption-inhibition technique
(C) Mixed agglutination technique
(D) Gel card technique

26. The Direct Antiglobulin Test (Direct Coombs test) is primarily utilized in a clinical laboratory to detect:
(A) Antibodies bound to red blood cells in vivo
(B) Unbound irregular antibodies in the patient's serum
(C) Soluble H blood group antigens present in human saliva
(D) Secretor status determined from dried seminal fluid stains

27. The Indirect Coombs test involves a two-stage process. What is its primary application?
(A) Determining the precise ABO blood group from a dried criminal bloodstain
(B) Screening serum for unexpected antibodies prior to transfusion
(C) Identifying the specific species origin of an unknown blood sample
(D) Detecting polymorphic erythrocyte isoenzymes in degraded blood

28. In the forensic examination of fresh blood samples, forward grouping determines the presence of cellular antigens. What does reverse grouping determine?
(A) The presence of specific cellular antigens on indicator red blood cells
(B) The presence of naturally occurring plasma antibodies
(C) The secretor status and soluble antigen expression of the individual
(D) The specific subgroup classification of the A blood group antigen

29. A forensic scientist receives a dried, flaking bloodstain from a crime scene weapon. Which technique was historically designed specifically to detect antibodies directly from such crusts?
(A) Lattes crust method
(B) Absorption-elution method
(C) Mixed agglutination
(D) Gel card technique

30. Which forensic technique used for dried bloodstains involves saturating the stain with specific antiserum, washing away unbound antibodies, and then raising the temperature to release the bound antibodies?
(A) Absorption-inhibition technique
(B) Lattes crust technique
(C) Absorption-elution technique
(D) Tube method

31. What is the standard temperature used during the final phase of the absorption-elution technique to break the antigen-antibody bonds and release the specific antibodies?
(A) 4°C
(B) 25°C
(C) 37°C
(D) 56°C

32. In the absorption-inhibition technique, a positive result for a specific blood group antigen in a stain is indicated by:
(A) Immediate and complete macroscopic agglutination of indicator cells
(B) The sudden and complete enzymatic hemolysis of indicator cells
(C) Absence or reduction of indicator cell agglutination
(D) The visible precipitation of a distinct white ring in a test tube

Click Here to Buy book on Flipkart

replacing traditional tube testing in major clinical and forensic laboratories for blood typing.
Reason (R): Gel cards provide stable, standardized, and objectively readable endpoints that can be photographically documented for legal records.
Select the correct answer from the options given below:
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

70. In forensic hair examination, blood grouping of the hair root sheath is possible using absorption-elution. This is primarily because the cells of the root sheath contain:
(A) Entrapped liquid plasma containing active serum proteins
(B) Naturally occurring circulating antibody molecules in high titers
(C) Complete and functional hemoglobin molecular complexes
(D) Cellular blood antigens matching those on erythrocytes

71. The condition known as "Rh incompatibility" becomes clinically significant during pregnancy when fetal red blood cells cross the placental barrier and sensitize the mother. This event is called:
(A) Hemolytic anemia
(B) Fetomaternal hemorrhage
(C) Disseminated intravascular coagulation
(D) Polycythemia vera

72. Which principle applies when utilizing the Lattes crust method on a 6-month-old dried bloodstain?
(A) Serum antibodies in dried bloodstains remain functional and stable much longer than membrane antigens.
(B) The analytical method specifically targets genomic DNA fragments rather than serum proteins in older stains.
(C) Antibodies degrade rapidly in dried stains, causing false negatives.
(D) Microscopic cell agglutination becomes completely irreversible over extended time in dry environments.

NODIA

73. Consider the following statements regarding the limitations of traditional blood grouping in forensic casework:
I. It cannot distinguish between two individuals with the same blood group.
II. Blood group antigens and antibodies can degrade under severe environmental conditions.
III. It cannot determine the exact time the bloodstain was deposited.
IV. It requires a significantly larger sample size compared to PCR-based DNA profiling.
Which of the above statement(s) is/are correct?
(A) I, II and IV only
(B) II, III and IV only
(C) I, III and IV only
(D) I, II, III and IV

74. Which classic forensic immunology test utilizes an agar gel plate with wells containing antiserum and sample extract to determine species origin by forming a visible band of precipitation?
(A) Ouchterlony double diffusion test
(B) Benzidine catalytic colorimetric blood test
(C) Kastle-Meyer phenolphthalein presumptive test
(D) Takayama hemochromogen microcrystal reagent test

75. Match List I with List II and select the correct answer from the options given below:
List I: (Technique)
P. Slide Method
Q. Absorption-Elution
R. Absorption-Inhibition
S. Lattes Crust
List II: (Fundamental Mechanism)
1. Reduction in specific antiserum titer due to soluble antigens in the sample.
2. Direct reaction of known indicator cells with antibodies present in a crust.
3. Rapid macroscopic observation of clumped cells on a flat glass surface.
4. Thermal breaking of antigen-antibody bonds after thorough washing.
(A) P-3, Q-4, R-1, S-2
(B) P-4, Q-3, R-2, S-1
(C) P-3, Q-1, R-4, S-2
(D) P-2, Q-4, R-1, S-3

76. Secretor status can be established by analyzing the saliva of an individual. In standard forensic practice, what is usually done to the saliva

(B) Lipoproteins
(C) Pure polysaccharides
(D) Glycoproteins

42. Arrange the following steps used to detect blood group substances in saliva by the absorption-inhibition technique in the correct sequential order:
I. Add indicator red blood cells to check for agglutination.
II. Boil the saliva sample to inactivate intrinsic enzymes.
III. Incubate the treated saliva with a known titer of specific antiserum.
IV. Centrifuge and collect the clear supernatant.
(A) I, II, III, IV
(B) II, IV, III, I
(C) IV, III, II, I
(D) III, II, I, IV

43. Which of the following serum proteins exhibits genetic polymorphism (phenotypes 1-1, 2-1, 2-2) and binds to free hemoglobin, historically serving as a genetic marker in forensic cases?
(A) Albumin
(B) Haptoglobin
(C) Transferrin
(D) Ceruloplasmin

44. The detection of different structural forms of an enzyme that catalyze the same reaction, known as isoenzymes, is traditionally performed in forensic science using which analytical technique?
(A) Gas Chromatography
(B) Electrophoresis
(C) Mass Spectrometry
(D) X-ray Diffraction

45. Human Leukocyte Antigens (HLA) are encoded by the Major Histocompatibility Complex (MHC). On which chromosome is the MHC gene cluster located?
(A) Chromosome 6
(B) Chromosome 9
(C) Chromosome 11
(D) Chromosome 21

46. Why was the HLA system considered the most powerful serological tool for determining paternity before the advent of DNA fingerprinting?
(A) It is strictly controlled by a single highly dominant allele present across populations.
(B) The cell-surface antigens are completely absent in newborn children and infants.
(C) It exhibits extreme genetic polymorphism with numerous haplotypes.
(D) The surface antigens can be easily visualized directly without using electron microscopes.

47. Consider the following statements regarding the forensic application of blood grouping in paternity disputes:
I. It can definitively prove that a specific man is the biological father.
II. It can conclusively exclude a falsely accused man from being the biological father.
III. It relies on Mendelian laws of inheritance.
Which of the above statement(s) is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

NODIA

48. In a disputed paternity case, the mother has blood group O, and the child has blood group O. Which of the following blood groups would definitively exclude a man from being the biological father?
(A) Blood Group A
(B) Blood Group B
(C) Group AB
(D) Blood Group O

49. If a child has blood group AB and the mother has blood group A, the biological father MUST possess at least one allele for which blood group antigen?
(A) O antigen
(B) B antigen
(C) A antigen
(D) Rh D antigen

50. Match List I with List II and select the correct answer from the options given below:
List I: (Blood Group Concept)
P. Universal Donor (Packed cells)
Q. Universal Recipient (Whole blood)
R. Amorph
S. Codominance
List II: (Associated Definition)
1. A gene that produces no functional product (e.g., O allele).
2. Group AB positive.
3. Group O negative.
4. Simultaneous expression of both alleles (e.g., A and B alleles).
(A) P-3, Q-2, R-1, S-4
(B) P-2, Q-3, R-4, S-1

(C) P-1, Q-4, R-3, S-2
(D) P-3, Q-2, R-4, S-1

51. The primary limitation of classical blood grouping (ABO, Rh, MNSs) as physical evidence in a criminal trial, compared to modern DNA profiling, is that traditional serology provides:
(A) Class evidence
(B) Individualized evidence
(C) Trace evidence
(D) Direct eyewitness evidence

52. When testing a suspected dried bloodstain, which crucial step must be performed to ensure the stain is actually human blood before attempting ABO grouping?
(A) Kastle-Meyer catalytic colorimetric presumptive test
(B) Luminol chemiluminescence reagent spray application
(C) Precipitin test or anti-human hemoglobin test
(D) Takayama microcrystalline crystal test for hemochromogen

53. The 'O' allele in the ABO system produces an inactive enzyme (an amorph) that fails to add a terminal sugar to the H antigen. Which terminal sugar is missing compared to the 'A' allele?
(A) N-acetylgalactosamine
(B) D-galactose monosaccharide sugar
(C) L-fucose terminal sugar unit
(D) D-glucose carbohydrate derivative

54. An individual with the genotype 'AO' expresses the Group A phenotype. The 'A' allele is completely dominant over the 'O' allele. What is the exact terminal sugar added to the H antigen by the A gene's glycosyltransferase?
(A) D-galactose monosaccharide
(B) N-acetylglucosamine derivative
(C) Sialic acid terminal group
(D) N-acetylgalactosamine

55. If a non-secretor leaves a saliva sample on an envelope flap, forensic serological testing using the absorption-inhibition method will show:
(A) High concentrations of soluble A or B antigens
(B) Absence of ABO blood group substances
(C) Exclusively H antigens present in the sample
(D) Complete enzymatic hemolysis of all indicator cells

56. What is the term for the process in which a known blood stain is subjected to heating or chemical treatment to break the antigen-antibody bond and recover the specifically bound antibodies for identification?
(A) Agglutination
(B) Precipitation
(C) Elution
(D) Sensitization

57. During the absorption phase of the absorption-elution method, why must the thoroughly washed bloodstain thread be incubated at a low temperature (usually 4°C)?
(A) To destroy heat-labile contaminating bacterial enzymes in the stain
(B) To rapidly dissociate the pre-formed antigen-antibody complex
(C) To completely lyse the red blood cells efficiently and rapidly
(D) To promote antibody uptake and binding to antigens

58. Consider the following statements regarding the characteristics of the Rh "null" phenotype:
I. Complete absence of all Rh system antigens.
II. Presence of unusually strong D antigens.
III. Red blood cells show structural abnormalities like stomatocytosis.
IV. Individuals can safely receive blood from any Rh positive donor.
Which of the above statement(s) is/are correct?
(A) I and III only
(B) II and IV only
(C) I, III and IV only
(D) I and II only

59. In the context of pre-transfusion compatibility testing, the "major crossmatch" involves reacting:
(A) Donor serum with recipient red blood cells
(B) Recipient serum with donor red blood cells
(C) Donor whole blood with recipient whole blood
(D) Recipient serum with O negative control cells

60. The presence of the anti-H lectin, derived from Ulex europaeus, causes the strongest agglutination reaction with red blood cells of which ABO group?
(A) Group A1
(B) Group O
(C) Group A1B

Downloaded from www.pdf.tube

(D) Group B

61. If a criminal case relies on identifying the blood group from a severely degraded stain that is several months old, which of the following is the most significant biochemical problem faced by the forensic examiner?
(A) Loss of antigenicity due to environmental denaturation
(B) Direct antibody conversion into completely new antigenic sites
(C) Spontaneous cellular synthesis of uncorrupted nuclear DNA molecules
(D) Complete ambient evaporation of the dried stain from the substrate

62. Consider the following statements regarding the Lattes crust method:
I. It requires only minute, microscopic fragments of a stain.
II. It directly detects the agglutinins (antibodies) present in the bloodstain.
III. It involves the use of known A, B, and O indicator red blood cells.
Which of the above statement(s) is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

63. A suspect with blood type O is accused of a crime. A fresh blood drop at the crime scene is tested and shows strong agglutination with both Anti-A and Anti-B antisera. Assuming no contamination, what does this indicate?
(A) The blood recovered from the scene definitively belongs to the suspect.
(B) The suspect is conclusively classified as a non-secretor individual.
(C) The suspect exhibits the rare genetic Bombay blood phenotype trait.
(D) The blood cannot belong to the suspect.

64. According to Mendelian genetics, a mating between an individual with genotype AB and an individual with genotype BO can result in offspring with all of the following blood group phenotypes EXCEPT:
(A) Group A
(B) Group B
(C) Group O
(D) Group AB

65. Select the correct sequence of routine forensic serological examination for an unknown reddish-brown stain suspected to be blood:
(A) ABO Grouping, Confirmatory Test, Presumptive Test, Species Identification
(B) Presumptive Test, Confirmatory Test, Species Identification, ABO Grouping
(C) Species Identification, Presumptive Test, ABO Grouping, Confirmatory Test
(D) Confirmatory Test, ABO Grouping, Species Identification, Presumptive Test

66. When performing the slide agglutination method, why is it critical to include appropriate positive and negative controls?
(A) To prevent the collected blood sample from clotting directly on the glass slide
(B) To effectively convert the standard slide method into a tube-based testing method
(C) To accurately detect the secretor status of the individual simultaneously in field conditions
(D) To verify antisera potency and avoid false agglutination

67. The phenomenon of "rouleaux formation", which can mimic true hemagglutination and cause a false positive result during blood typing, is characterized by:
(A) Red blood cells stacking like coins from high protein levels
(B) Irreversible complement-mediated lysis of the erythrocyte membrane structure
(C) Permanent high-affinity covalent bonding between serum antibodies and cell antigens
(D) The complete enzymatic destruction of cellular surface H antigen structures

NODIA

68. The Lutheran blood group system antigens (Lua and Lub) exhibit distinct behavior when exposed to certain enzymes used in blood banking. Which characteristic defines their linkage?
(A) They are strictly linked to sex-determining X and Y chromosomes in humans.
(B) They are exclusively expressed in human saliva and other mucosal secretions.
(C) The locus is linked to the Secretor locus on chromosome 19.
(D) They serve as primary causative factors of neonatal alloimmune thrombocytopenia.

69. Given below are two statements, one labelled as Assertion (A) and the other as Reason (R):
Assertion (A): Gel card technology is increasingly

(D) Domesticated sheep

12. Among the common Rh antigens, which one is considered the most highly immunogenic and determines whether an individual is classified as "Rh positive"?
(A) C antigen
(B) D antigen
(C) c antigen
(D) E antigen

13. Haemolytic disease of the newborn (Erythroblastosis fetalis) typically arises under which specific condition of Rh incompatibility?
(A) Rh negative mother and Rh positive fetus
(B) Rh positive mother and Rh negative fetus
(C) Rh positive mother and Rh positive fetus
(D) Rh negative mother and Rh negative fetus

14. Which system of nomenclature uses the symbols D, C, c, E, and e to represent the antigens of the Rh blood group system?
(A) Wiener nomenclature
(B) Rosenfield nomenclature
(C) Fisher-Race nomenclature
(D) ISBT numerical nomenclature

15. Consider the following statements regarding the MNSs blood group system:
I. It was discovered by Landsteiner and Levine.
II. M and N antigens are located on glycophorin A.
III. It is strongly associated with severe hemolytic transfusion reactions.
Which of the above statement(s) is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

16. The Kell blood group system is primarily known for which pair of antithetical antigens?
(A) Jka and Jkb
(B) Fya and Fyb
(C) K and k
(D) Lua and Lub

17. The Duffy blood group phenotype Fy(a-b-) provides a natural resistance to infection by which human pathogen?
(A) Plasmodium falciparum
(B) Plasmodium vivax
(C) Leishmania donovani
(D) Trypanosoma cruzi

18. Which blood group system is unique because its antigens are not synthesized directly by erythrocytes, but are instead absorbed onto the red cell membrane from blood plasma?
(A) Kidd system
(B) P system
(C) Lutheran system
(D) Lewis system

19. Delayed hemolytic transfusion reactions, which often occur days after a transfusion due to an anamnestic antibody response, are most classically associated with which blood group system?
(A) Kidd system
(B) ABO system
(C) MNSs system
(D) P system

20. Given below are two statements, one labelled as Assertion (A) and the other as Reason (R):
Assertion (A): Group O negative individuals are universally considered ideal whole-blood donors in emergency mass-casualty situations.
Reason (R): Group O negative red blood cells lack A, B, and D antigens, preventing immediate acute hemolytic reactions in recipients.
Select the correct answer from the options given below:
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

21. Which specific antigen defines the P blood group system's most common phenotype (P1)?
(A) P1 antigen
(B) Pk antigen
(C) Luke antigen
(D) p antigen

22. In clinical blood transfusion practice, an individual with blood group AB positive is designated as a universal recipient because their blood serum completely lacks:
(A) Specific circulating membrane Rh antigens
(B) High-density cell-surface H antigens
(C) Transmembrane erythrocyte glycophorins
(D) Anti-A and Anti-B serum antibodies

23. Which basic blood grouping method relies on observing visible clumping of red cells on a flat

Click Here to Buy book on Amazon

sample immediately after collection to stabilize it for the absorption-inhibition test?
(A) It is rapidly frozen in liquid nitrogen at -196°C to preserve enzymatic activity.
(B) It is boiled for 10 minutes to heat-inactivate enzymes.
(C) It is mixed thoroughly with concentrated sulfuric acid to denature all present salivary proteins.
(D) It is diluted with cold pure ethanol to selectively precipitate high-molecular-weight proteins.

77. The alleles governing the MNSs blood group system are highly informative in paternity testing. The M and N alleles show which genetic relationship?
(A) Codominance
(B) Complete dominance of M over N
(C) Complete dominance of N over M
(D) Sex-linked recessive inheritance

78. Arrange the progression of discoveries regarding blood group systems in chronological order from earliest to latest:
I. Rh Blood Group System
II. ABO Blood Group System
III. HLA System Overview
IV. MNSs Blood Group System
Which of the following represents the correct sequence?
(A) II, IV, I, III
(B) II, I, IV, III
(C) I, II, III, IV
(D) IV, II, I, III

79. The blood group substance specific to group 'B' individuals involves the enzymatic addition of which terminal sugar?
(A) L-fucose
(B) N-acetylgalactosamine
(C) D-mannose
(D) D-galactose

80. In blood grouping, "panagglutination" refers to a condition where:
(A) Complete failure of red blood cells to produce visible agglutination with any commercial testing antisera.
(B) Total absence of all naturally occurring isoagglutinin antibodies within the tested blood serum sample.
(C) Spontaneous agglutination of red cells with all antisera.
(D) Specific hemagglutination reactions occurring exclusively under extreme environmental temperature conditions.

NODIA

81. The term "titer" in serological testing refers to:
(A) The exact physical mass of the soluble target antigen measured precisely in milligrams per deciliter.
(B) The reciprocal of the highest serum dilution producing visible agglutination.
(C) The optimal environmental temperature at which maximal macroscopic cell agglutination occurs.
(D) The specific spectrophotometric wavelength of light absorbed by the antigen-antibody complex.

82. Consider the following body fluids:
I. Saliva
II. Semen
III. Gastric juice
From which of the above body fluids can secretor status be reliably determined?
(A) I and II only
(B) I and III only
(C) II and III only
(D) I, II and III

83. A bloodstain from a crime scene is submitted for forensic analysis. During the absorption-elution test for the ABO group, the blank control thread (substrate control) shows agglutination with indicator cells. What must the forensic expert conclude?
(A) The test is invalid due to substrate interference.
(B) The tested blood sample belongs conclusively to a group AB individual.
(C) The suspect is definitively identified as a secretor of group substances.
(D) The preliminary washing step was executed perfectly without error.

84. A known sample of group A liquid blood is inadvertently mixed with group B liquid blood during a laboratory mishap. If this mixed sample is tested using standard forward grouping antisera, what will be the expected result?
(A) Total absence of agglutination with either Anti-A or Anti-B antisera.
(B) Strong macroscopic agglutination occurring selectively only with Anti-A antiserum.
(C) Agglutination with both Anti-A and Anti-B.
(D) Strong macroscopic agglutination occurring

crust are exposed directly to known group A, B, and O indicator red blood cells. Observation of microscopic agglutination indicates the presence of corresponding functional isoagglutinin antibodies in the dried stain.

30. (C) Absorption-elution technique
The absorption-elution method is a highly sensitive forensic serology technique used for ABO grouping of dried bloodstains. Bloodstain fibers are incubated with specific antisera to allow antibody binding to target antigens. Unbound antibodies are washed away thoroughly, and heat is applied to break antigen-antibody bonds, releasing free antibodies into solution for agglutination testing with indicator cells.

31. (D) 56°C
Heat-induced elution in the absorption-elution method requires raising the temperature of the reaction mixture to 56°C. At this temperature, non-covalent hydrophobic and electrostatic interactions between antigen epitopes and antibody binding sites are disrupted without completely denaturing antibody protein structure. Reversible dissociation releases functional antibodies into the supernatant for indicator red cell agglutination.

32. (C) Absence or reduction of indicator cell agglutination
The absorption-inhibition technique measures the neutralization of known antiserum titers by soluble antigens or stain extracts. If the target blood group antigen is present in the sample, it binds and neutralizes the specific antibody in antiserum. Upon adding indicator red blood cells, no antibodies remain free, resulting in an absence or significant reduction of cell agglutination.

33. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Absorption-elution is superior to absorption-inhibition for analyzing small, dried forensic bloodstains. The method directly isolates bound antibodies from antigenic sites and concentrates them into a small elution volume. This technique significantly enhances analytical sensitivity, enabling successful ABO blood typing from single stained thread fibers that lack sufficient antigen mass required to cause measurable antiserum titer reduction.

34. (D) Tissue cells, hair roots, and mucosal cells
The mixed agglutination technique detects ABO antigens on non-erythrocyte cellular samples, such as hair root sheaths, epidermal cells, and buccal mucosal tissue. Specific antibodies bind to antigens present on cell surfaces, followed by addition of indicator red blood cells. The indicator cells adhere to free antibody arms, forming visible microscopic mixed cell agglutinates around the tissue structures.

35. (A) Bacterial contamination producing A or B-like substances
Environmental exposure of bloodstains promotes bacterial growth. Certain bacteria, including strains of Escherichia coli and Proteus, possess cell wall lipopolysaccharides with chemical structures identical or strikingly similar to human A or B blood group antigens. Bacterial contamination produces false-positive serological reactions during bloodstain typing by binding commercial testing antisera or capturing indicator erythrocytes non-specifically.

36. (C) FUT2
Secretor status is governed by the FUT2 gene, located on chromosome 19. The FUT2 locus encodes alpha-1,2-fucosyltransferase, an enzyme responsible for synthesizing soluble H antigen precursor in epithelial mucosal tissues. Expression of the dominant Se allele of FUT2 allows secretion of water-soluble A, B, and H group glycoproteins into body secretions such as saliva, semen, and sweat.

37. (D) 80%
In human populations, approximately 80 percent of individuals carry at least one functional dominant Se allele at the FUT2 gene locus, classifying them genetically as secretors. These individuals produce alpha-1,2-fucosyltransferase in mucosal glands, causing soluble ABO blood group substances to be present in high concentrations within body fluids like saliva, semen, gastric juices, and tears.

38. (B) Addition of antiserum, Washing, Thermal elution, Addition of indicator cells
The absorption-elution method follows a precise sequential protocol. First, the dried bloodstain thread is incubated with specific antiserum to allow antigen-antibody binding. Second, extensive washing removes all unbound antibody proteins. Third, heat incubation at 56°C

Downloaded from www.pdf.tube

ANSWERS

1. (B) Karl Landsteiner
Karl Landsteiner discovered the ABO blood group system in 1900 while working at the Pathological-Anatomical Institute in Vienna. He observed that serum from certain individuals agglutinated red blood cells of others. This ground-breaking discovery laid the foundation for safe blood transfusions, forensic serology, and immunogenetics, earning him the Nobel Prize in Physiology or Medicine in 1930.

2. (D) The corresponding antibody will be absent from their blood serum.
Landsteiner's Law governs red cell immunology and states that if a specific antigen is present on red blood cells, the corresponding antibody must be absent from the serum. Conversely, if an antigen is absent on erythrocytes, the corresponding antibody will be present in the plasma of individuals whose immune system has reached functional maturity.

3. (A) A and B antigens on red blood cells, and neither Anti-A nor Anti-B in serum.
Erythrocytes of group AB individuals express both A and B codominant carbohydrate antigens on their cell membranes. According to Landsteiner's rule, because both antigens are present, the plasma completely lacks isoagglutinins, meaning neither anti-A nor anti-B antibodies are circulating. Consequently, group AB plasma will not cause agglutination when exposed to erythrocytes carrying A or B antigens.

4. (C) H antigen
The rare Bombay phenotype arises from a homozygous recessive mutation in the FUT1 gene, leading to a complete absence of fucosyltransferase enzyme activity. Without this enzyme, the precursor oligosaccharide chain cannot incorporate L-fucose to build the H antigen. Consequently, red blood cells lack H antigens entirely, preventing the subsequent attachment of A or B blood group sugars.

5. (A) Group O
Standard forward grouping relies on commercial anti-A and anti-B antisera reacting with surface antigens. Because Bombay phenotype red blood cells lack both A and B antigens due to missing the essential H precursor, no agglutination occurs with either antiserum. This negative reaction causes Bombay blood to mimic standard group O blood, although serum testing reveals strong anti-H antibodies.

6. (D) Dolichos biflorus
Lectins are plant-derived seed proteins that bind specifically to surface carbohydrates. The lectin extracted from Dolichos biflorus seeds agglutinates A1 erythrocytes with high specificity due to the higher density of A antigens, while failing to agglutinate A2 cells. This property makes Dolichos biflorus a standard serological reagent for distinguishing the subgroup A1 from subgroup A2.

(B) Chromosome 9
The ABO gene is mapped to the long arm of chromosome 9 at locus 9q34.2. This gene encodes glycosyltransferase enzymes that transfer specific monosaccharide units to the H antigen backbone. Inherited as autosomal codominant alleles, the variations at this chromosomal site dictate the expression of glycosyltransferases, producing A, B, or non-functional O alleles across human populations.

8. (C) Group A
Genetic inheritance of the ABO system follows Mendelian principles, where the A allele is dominant over the silent O allele. An individual inheriting an A allele from one parent and an O allele from the other parent will have the heterozygous genotype AO. Because the A allele encodes functional glycosyltransferase, the phenotypic expression is blood group A.

9. (D) IgM
Naturally occurring anti-A and anti-B antibodies in the ABO system are primarily composed of immunoglobulin M molecules. These pentameric antibodies develop spontaneously within the first few months of life following exposure to environmental microorganisms carrying similar carbohydrate structures. Due to their large size, IgM antibodies efficiently activate complement

NODIA

48. (C) Group AB
An individual with group AB blood possesses one A allele and one B allele, obligatorily passing one allele to offspring. Consequently, an AB father cannot produce a group O child, as group O requires two silent O alleles, one from each parent. Thus, an alleged father with group AB is conclusively excluded.

49. (B) B antigen
A child with blood group AB inherits two codominant alleles, one A allele and one B allele. If the biological mother has blood group A, she can contribute the A allele. The biological father must therefore contribute the obligatory B allele, meaning the father must express at least one functional B allele and display B antigen activity.

50. (A) P-3, Q-2, R-1, S-4
Universal donor packed cells refer to O negative blood, which lacks A, B, and D antigens. Universal whole blood recipients are AB positive due to absence of anti-A and anti-B antibodies. An amorphic gene, such as the O allele, produces no detectable product. Codominance involves simultaneous full phenotypic expression of both alleles, as seen in AB group individuals.

51. (A) Class evidence
Classical blood grouping systems categorze individuals into broad genetic groups shared by substantial proportions of the general population. Because millions of people share the same ABO or Rh blood group phenotypes, classical serological results provide class evidence that can include or exclude potential suspects, but cannot uniquely individualize a stain to a single source like DNA profiling.

52. (C) Precipitin test or anti-human hemoglobin test
Before performing blood grouping on crime scene stains, species origin must be established. Chemical tests like Kastle-Meyer or Takayama only confirm that a stain contains heme, which is present in human and animal blood alike. The precipitin test or anti-human hemoglobin immunochromatographic assay uses specific anti-human antibodies to verify human origin before proceeding with ABO typing.

53. (A) N-acetylgalactosamine
The ABO gene encodes glycosyltransferases that attach specific immunodominant sugar units to the H antigen precursor. The A allele encodes alpha-1,3-N-acetylgalactosaminyltransferase, which adds N-acetylgalactosamine to form the A antigen. In contrast, the O allele contains a deletion causing a frameshift mutation, yielding an inactive enzyme (amorph) that fails to add N-acetylgalactosamine, leaving H antigen unmodified.

54. (D) N-acetylgalactosamine
Standard genetics terminology provides foundational distinctions in immunogenetics. Phenotype represents observable physical or biochemical traits expressed by an organism. Genotype defines the underlying inherited genetic constitution. An allele is an alternative functional form of a gene, while locus denotes the specific physical location or structural address of a gene on a chromosome.

55. (B) Absence of ABO blood group substances
Non-secretors carry the homozygous recessive sese genotype at the FUT2 gene locus, resulting in lack of functional alpha-1,2-fucosyltransferase in exocrine glands. Without this enzyme, soluble H antigen precursor and subsequent A or B group substances cannot be synthesized in salivary tissue. Serological testing of non-secretor saliva via absorption-inhibition demonstrates a complete absence of blood group substances.

56. (C) Elution
Elution is the process of breaking non-covalent antigen-antibody bonds to recover bound antibodies from target cells or substrate matrices into liquid solution. In forensic serology, physical methods such as heat application or chemical treatments dissociate bound isoagglutinins from dried bloodstain antigens, allowing free antibodies to be isolated and subsequently identified using indicator red blood cells.

57. (D) To promote antibody uptake and binding to antigens
Antigen-antibody binding reactions in the ABO system involve exothermic physical interactions between immunoglobulin binding sites and sugar epitopes. Lowering the temperature to 4°C during the initial absorption phase stabilizes these non-covalent bonds, enhancing antibody affinity and maximizing binding efficiency of specific antisera to small amounts of dried bloodstain antigens on substrate threads.

Click Here to Buy book on Flipkart

production, leading to delayed extravascular hemolytic transfusion reactions days later.

20. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Group O negative packed red blood cells lack A, B, and Rh D cell surface antigens. Because these cells do not carry major target antigens, they will not react with anti-A, anti-B, or anti-D antibodies circulating in a recipient's plasma, preventing acute complement-mediated destruction during emergency transfusions when blood typing is impossible.

21. (A) P1 antigen
The P blood group system consists of carbohydrate antigens synthesized by sequential glycosyltransferase activity. The most prevalent phenotype in human populations is P1, which is defined specifically by the presence of the P1 antigen on red blood cells. Erythrocytes lacking P1 antigen are classified as P2 or rarer null phenotypes.

22. (D) Anti-A and Anti-B serum antibodies
Individuals with AB positive blood group express both A and B carbohydrate antigens along with the Rh D antigen on their red cell membranes. Following Landsteiner's rule of blood grouping, their plasma does not develop circulating anti-A or anti-B antibodies. Without these isoagglutinins, they can receive red blood cells from any ABO type without immune-mediated hemolysis.

23. (B) Slide method
The slide method is a simple, rapid technique used for preliminary blood grouping. A suspension of red blood cells is mixed directly with commercial antisera on a glass slide at room temperature. Agglutination is observed macroscopically within one to two minutes as visible red cell clumping, making it suitable for rapid field screening.

24. (B) I, II and IV only
The tube method offers several advantages over slide testing in serological analysis. Tubes prevent evaporation, allowing extended incubation periods without drying. The technique uses smaller reagent volumes, and gentle centrifugation promotes cell-antibody contact, increasing sensitivity for detecting weak antigen-antibody reactions rather than decreasing sensitivity, while providing reproducible results for blood typing.

25. (D) Gel card technique
Gel card technology utilizes microtubes containing a dextran-acrylamide gel matrix pre-dispensed with specific antisera. During centrifugation, agglutinated red blood cells are trapped at the gel matrix surface because of their larger size. Unagglutinated single cells migrate freely through the gel pore spaces to form a pellet at the bottom, allowing precise interpretation.

26. (A) Antibodies bound to red blood cells in vivo
The Direct Antiglobulin Test, or Direct Coombs test, detects antibodies or complement proteins bound directly to erythrocyte surfaces in vivo. Patient red cells are washed to remove unbound proteins and mixed with anti-human globulin. Agglutination indicates sensitization, serving as a diagnostic tool for autoimmune hemolytic anemia, hemolytic disease of the newborn, and transfusion reactions.

27. (B) Screening serum for unexpected antibodies prior to transfusion
The Indirect Antiglobulin Test evaluates in vitro antigen-antibody interactions. Serum is incubated with reagent red blood cells, allowing potential circulating antibodies to bind. After washing away unbound immunoglobulins, anti-human globulin is added to produce visible agglutination. This two-stage method is widely used for pre-transfusion antibody screening, crossmatching, and erythrocyte antigen typing.

28. (B) The presence of naturally occurring plasma antibodies
In complete ABO blood grouping of liquid blood samples, forward grouping identifies erythrocyte membrane antigens using known commercial antisera. Reverse grouping confirms the findings by detecting naturally occurring isoagglutinins present in the individual's plasma or serum. Serum is reacted with known group A1 and group B reagent red blood cells to verify expected agglutination patterns.

29. (A) Lattes crust method
The Lattes crust technique was developed by Leon Lattes to determine the ABO group of dried blood crusts by identifying serum antibodies. Microscopic fragments of bloodstain

Downloaded from www.pdf.tube

and cause strong intravascular agglutination of red blood cells.

10. (A) Agglutination with Ulex europaeus lectin
The H antigen serves as the essential biochemical precursor for both A and B blood group antigens. Serological detection of the H antigen relies on seed extracts from Ulex europaeus, which contain a specific lectin that binds to alpha-L-fucose residue. Exposure of erythrocytes to Ulex europaeus lectin produces visible agglutination, confirming the presence of functional H antigen.

11. (B) Rhesus monkey
The Rh blood group system was discovered in 1940 by Karl Landsteiner and Alexander Wiener. They immunized rabbits and guinea pigs with red blood cells from Rhesus monkeys (Macaca mulatta) to produce antibodies. The resulting antiserum agglutinated red cells from all Rhesus monkeys and approximately 85 percent of human blood samples, leading to the designation Rh factor.

12. (B) D antigen
Among the primary antigens within the Rh blood group system, the D antigen exhibits the highest degree of immunogenicity. Exposure of an Rh-negative individual to even small quantities of D-positive erythrocytes frequently triggers an immune response with production of anti-D antibodies. Consequently, individuals expressing the D antigen on red cells are clinically designated as Rh positive.

13. (A) Rh negative mother and Rh positive fetus
Erythroblastosis fetalis occurs when an Rh-negative mother carries an Rh-positive fetus. Transplacental hemorrhage during delivery causes maternal exposure to fetal D antigens, sensitizing the mother to produce anti-D IgG antibodies. In subsequent pregnancies with an Rh-positive fetus, these maternal IgG antibodies cross the placenta, binding to fetal red cells and causing severe hemolytic anemia.

14. (C) Fisher-Race nomenclature
The Fisher-Race nomenclature system assumes that Rh antigens are controlled by three closely linked gene loci on chromosome 1, designated as C/c, D/d, and E/e. Under this system, letter symbols denote the specific individual antigens present on the erythrocyte membrane, providing a clear and standardized method for describing Rh genotypes and phenotypes.

15. (A) I and II only
The MNSs blood group system was discovered in 1927 by Karl Landsteiner and Philip Levine. Its M and N antigens reside on glycophorin A, a major transmembrane sialoglycoprotein of human red blood cells. Antibodies against M and N antigens are typically naturally occurring IgM molecules that rarely cause severe clinical hemolytic transfusion reactions.

16. (C) K and k
The Kell blood group system is defined by its primary antithetical antigen pair, K (Kell) and k (Cellano). The K antigen is highly immunogenic, capable of triggering potent antibody responses upon transfusion or during pregnancy. Antibodies to K and k antigens are primarily IgG, causing severe immune hemolytic transfusion reactions and fetal anemia.

NODIA

17. (B) Plasmodium vivax
Erythrocytes with the Fy(a-b-) phenotype lack Duffy antigen receptor for chemokines. The protozoan parasite Plasmodium vivax requires this specific transmembrane glycoprotein to attach to and invade human red blood cells. Consequently, individuals expressing the null Fy(a-b-) phenotype possess a natural resistance against malaria caused by Plasmodium vivax, a trait common in West Africa.

18. (D) Lewis system
The Lewis blood group system is unique because its antigens are not synthesized intracellularly by erythroid precursors. Instead, fucosyltransferase enzymes encoded by FUT3 synthesize soluble glycolipids in tissue cells, which are secreted into plasma and lymph. These circulating Lewis glycolipids subsequently adsorb passively onto the outer lipid bilayer membrane of circulating erythrocytes.

19. (A) Kidd system
Antibodies belonging to the Kidd blood group system, directed against Jka and Jkb antigens, characteristically decline rapidly in antibody concentration to undetectable levels after primary immunization. Upon re-exposure to antigen via blood transfusion, an anamnestic secondary immune response causes rapid IgG antibody

dissociates bound antibodies from antigens. Finally, indicator red cells are added to detect freed antibodies through visible agglutination.

39. (B) A secretor
Soluble ABO blood group antigens appear in seminal plasma only when an individual carries the functional dominant Se allele. If a suspect is a non-secretor, their seminal fluid will not express ABO blood group substances regardless of erythrocyte blood type. Establishing that a suspect is a secretor is therefore necessary before interpreting absorption-inhibition serological test results.

40. (A) P-1, Q-3, R-2, S-4
Polymorphic enzymes and serum proteins serve as historical genetic markers in forensic science. Phosphoglucomutase is a highly polymorphic erythrocyte enzyme useful for stain discrimination. Erythrocyte Acid Phosphatase exhibits distinct phenotypic degradation patterns over storage duration. Haptoglobin is a polymorphic serum protein used in paternity testing, while Glyoxalase I is encoded by multiple alleles located on chromosome 6.

41. (D) Glycoproteins
Soluble ABO blood group substances present in body fluids like saliva, semen, and gastric juice are biochemically categorized as glycoproteins. These macromolecular structures consist of a central polypeptide core anchored to multiple branching carbohydrate side chains. In contrast, erythrocyte membrane-bound ABO antigens exist primarily as glycolipids, highlighting structural differences between tissue secretions and cell membrane forms.

42. (B) II, IV, III, I
Detecting soluble ABO antigens in saliva using absorption-inhibition follows a specific protocol. Saliva is first boiled to heat-inactivate intrinsic enzymes that could destroy antibody reagents. Centrifugation then yields a clear supernatant containing group substances. Incubating the supernatant with known antiserum titers allows antigen neutralization, after which indicator red blood cells are added to evaluate agglutination inhibition.

43. (B) Haptoglobin
Haptoglobin is an alpha-2 globulin serum glycoprotein that binds free hemoglobin with high affinity to prevent renal oxidative damage. It exhibits genetic polymorphism determined by two autosomal codominant alleles, Hp1 and Hp2, resulting in three major phenotypes: Hp 1-1, Hp 2-1, and Hp 2-2. Electrophoretic separation of haptoglobin historically served as an important marker in forensic individualization.

44. (B) Electrophoresis
Electrophoresis is the standard analytical technique used to resolve isoenzymes, which are structurally distinct variants of an enzyme sharing identical catalytic function. Different isoenzymes possess distinct net molecular charges and sizes, causing them to migrate at different rates through a support medium like starch or polyacrylamide gel when subjected to an electric field.

45. (A) Chromosome 6
The Major Histocompatibility Complex encoding Human Leukocyte Antigens is mapped to the short arm of chromosome 6 at band 6p21.3. This dense gene cluster spans several megabases and contains highly polymorphic genes responsible for immune self-recognition, antigen presentation to T lymphocytes, and regulation of cellular immune responses in human physiology.

46. (C) It exhibits extreme genetic polymorphism with numerous haplotypes.
Before the advent of short tandem repeat DNA profiling, the HLA system was the most discriminating genetic tool for parentage testing. The HLA gene loci exhibit extreme genetic polymorphism, possessing hundreds of distinct alleles that recombine into countless unique haplotypes, yielding an exceptionally high probability of exclusion when evaluating disputed paternity.

47. (B) II and III only
Classical blood group inheritance operates under strict Mendelian laws. Serological testing can conclusively exclude an alleged father if the child possesses an antigen that neither parent carries or lacks an antigen the alleged father must pass on. However, because blood groups are shared by large populations, matching phenotypes cannot definitively confirm paternity, providing inclusionary probability rather than absolute proof.

Click Here to Buy book on Amazon

selectively only with Anti-B antiserum.

85. Match List I with List II and select the correct answer from the options given below:
List I: (Term)
P. Phenotype
Q. Genotype
R. Allele
S. Locus
List II: (Description)
1. Alternative form of a gene at a specific position.
2. The exact physical location of a gene on a chromosome.
3. The observable physical or biochemical expression of a trait.
4. The underlying genetic constitution of an individual.
(A) P-3, Q-4, R-1, S-2
(B) P-4, Q-3, R-2, S-1
(C) P-3, Q-2, R-1, S-4
(D) P-1, Q-4, R-3, S-2

86. Which blood group is generally considered the most frequent in the native population of the Indian subcontinent?
(A) Group A
(B) Group O
(C) Group AB
(D) Group B

87. In forensic serology, to conclusively rule out maternity (excluding the possibility of a woman being the biological mother of a child), which of the following scenarios must be proven?
(A) Biological mother is Group A, Child is Group A
(B) Mother is AB, Child is O
(C) Biological mother is Group O, Child is Group O
(D) Biological mother is Group B, Child is Group B

88. Given below are two statements, one labelled as Assertion (A) and the other as Reason (R):
Assertion (A): Blood typing of degraded stains can sometimes yield a false "O" grouping result.
Reason (R): If the A or B antigens on the red cell fragments have been destroyed by environmental factors, they will not react with antisera, falsely appearing as an absence of antigens.
Select the correct answer from the options given below:
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

NODIA

89. An individual with the blood group phenotype A2B will typically show which reaction pattern during standard forward grouping?
(A) Visible agglutination occurring exclusively with Anti-A testing antisera
(B) Visible agglutination occurring exclusively with Anti-B testing antisera
(C) Total lack of visible agglutination with any standard testing antisera
(D) Agglutination with Anti-A and Anti-B

90. When distinguishing between human blood and animal blood at a crime scene, the detection of the ABO system is exclusively human. However, which of the following animals is known to possess a blood group system strikingly similar to human ABO, often confusing early serological experiments?
(A) Higher primates like chimpanzees
(B) Domesticated canine species (e.g., Canis lupus familiaris)
(C) Common avian species (e.g., Columba livia pigeons)
(D) Reptilian species (e.g., Squamata and Crocodilia)

58. (A) I and III only
The rare Rh null phenotype is characterized by complete absence of all Rh system antigens on erythrocyte membranes due to mutations in RHAG or RHCE genes. Because Rh membrane proteins maintain cell membrane structural integrity, Rh null erythrocytes exhibit structural abnormalities, particularly stomatocytosis and shortened lifespan, leading to mild chronic hemolytic anemia.

59. (B) Recipient serum with donor red blood cells
Major crossmatch is a critical pre-transfusion safety procedure designed to prevent immediate hemolytic reactions. The test involves incubating serum from the intended recipient with red blood cells from the donor unit. Observing for agglutination or hemolysis ensures that recipient serum does not contain pre-existing antibodies directed against donor cell surface antigens.

60. (B) Group O
Anti-H lectin, derived from Ulex europaeus, specifically recognizes and binds to unchanged alpha-L-fucose on the H precursor antigen. Because group O red blood cells do not convert H antigen into A or B antigens due to lacking active transferases, they possess the highest density of unmodified H antigen on their surface, producing strongest agglutination reactions.

61. (A) Loss of antigenicity due to environmental denaturation
Extended environmental exposure of bloodstains causes progressive degradation of biological molecules. Ultraviolet radiation, humidity, heat, and microbial activity break down cellular membrane glycolipids and glycoproteins. This structural destruction leads to loss of antigenicity, preventing specific antisera from binding to target epitopes during serological testing and frequently producing inconclusive or false-negative grouping results.

62. (B) II and III only
The Lattes crust method directly evaluates functional antibodies present in bloodstain crusts by adding known A, B, and O indicator red blood cells. However, because serum antibodies degrade much faster than membrane-bound antigens, the method requires substantial crust material rather than minute microscopic fragments, making statement I incorrect while statements II and III remain valid.

63. (D) The blood cannot belong to the suspect.
A fresh crime scene blood drop showing strong agglutination with both Anti-A and Anti-B antisera expresses both A and B surface antigens, defining the phenotype as group AB. Because a suspect with group O blood lacks A and B antigens entirely, the crime scene stain cannot have originated from this suspect, serving as a exclusion in forensic comparison.

64. (C) Group O
Mating between parents with genotypes AB and BO yields offspring genotypes through Mendelian segregation: AB, AO, BB, and BO. Phenotypically, these genotypes express as blood group AB, group A, or group B. Group O phenotype requires inheriting two silent O alleles (OO genotype). Because the AB parent passes only A or B, producing group O offspring is impossible.

65. (B) Presumptive Test, Confirmatory Test, Species Identification, ABO Grouping
Systematic forensic examination of unknown stains follows a logical hierarchy to conserve sample and ensure valid results. First, a sensitive presumptive test indicates the possible presence of blood. Second, a specific confirmatory test verifies blood identity. Third, species identification confirms human origin. Finally, ABO blood grouping or individualizing DNA profiling is conducted on confirmed human blood.

66. (D) To verify antisera potency and avoid false agglutination
In serological agglutination assays, experimental controls validate analytical reliability. A positive control containing known target red blood cells confirms antisera potency and reactivity. A negative control containing non-target cells or saline ensures reagents do not cause non-specific clumping. Together, these controls prevent erroneous interpretations caused by degraded reagents, contamination, or autoagglutination.

67. (A) Red blood cells stacking like coins from high protein levels
Rouleaux formation is a physiological pseudo-agglutination phenomenon where erythrocytes adhere along their concave surfaces, resembling stacks of coins. Raised plasma concentrations of high molecular weight proteins, such as fibrinogen or immunoglobulins, reduce repulsive

Downloaded from www.pdf.tube

zeta potential between red cells. Adding saline disperses rouleaux formations, distinguishing them from true, irreversible antibody-mediated cell agglutination.

68. (C) The locus is linked to the Secretor locus on chromosome 19.
The Lutheran blood group system encodes transmembrane glycoprotein antigens Lua and Lub. Gene mapping studies demonstrated that the Lutheran locus (LU) is physically linked to the Secretor locus (FUT2) on chromosome 19q13.32. This genetic linkage was one of the earliest autosomal gene linkages discovered in human genetics, displaying co-inheritance during genetic mapping analyses.

69. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Gel card technology provides standardized, reproducible blood typing by eliminating subjective pipetting and manual tube shaking variations. Agglutinated red cells remain trapped at distinct positions within gel microtubes after centrifugation. These stable visual endpoints can be easily read, digitally scanned, and archived, providing objective photographic documentation essential for legal and clinical records.

70. (D) Cellular blood antigens matching those on erythrocytes
Cells forming the hair root sheath derive from epithelial tissues that express ABO surface antigens identical to those on erythrocytes. Fucosyltransferase and glycosyltransferase enzymes synthesize A, B, and H membrane glycolipids within outer root sheath cells. Consequently, absorption-elution techniques can isolate these tissue antigens, enabling successful ABO blood grouping from shed hair root bulbs.

71. (B) Fetomaternal hemorrhage
Fetomaternal hemorrhage refers to the transplacental entry of fetal erythrocytes into maternal blood circulation during pregnancy or delivery. In an Rh-negative mother carrying an Rh-positive fetus, exposure to fetal D-positive red cells stimulates maternal immune recognition. Maternal lymphocytes produce anti-D antibodies, sensitizing the mother and predisposing subsequent Rh-positive pregnancies to erythroblastosis fetalis.

72. (C) Antibodies degrade rapidly in dried stains, causing false negatives.
The primary limitation of testing aged bloodstains using the Lattes crust method is antibody instability. Immunoglobulin molecules present in serum degrade rapidly upon drying and environmental exposure to air, heat, and moisture. In contrast to durable membrane antigens, serum antibodies lose structural binding capacity within months, yielding false negative results when testing older bloodstains.

73. (D) I, II, III and IV
Classical serology has significant forensic limitations. Phenotypic blood groups are shared by large populations, preventing absolute individualization. Environmental exposure causes antigen degradation, and serological methods cannot determine stain deposition age. Additionally, classic serology requires milligram-scale protein samples, whereas modern PCR DNA profiling amplifies picogram quantities of DNA, demonstrating all four limitations.

74. (A) Ouchterlony double diffusion test
The Ouchterlony double diffusion assay is an immunodiffusion technique used in forensic laboratories to identify species origin. Antiserum and extracted sample are loaded into opposing wells cut into agar gel. As antibodies and antigens diffuse radially toward each other, antigen-antibody binding creates an insoluble immune complex, appearing as a visible precipitation line at optimal concentration.

75. (A) P-3, Q-4, R-1, S-2
Serological methods rely on distinct mechanisms. The slide method provides rapid visual clumping on glass slides. Absorption-elution isolates bound antibodies through thermal breaking of antigen-antibody bonds at 56°C. Absorption-inhibition measures antiserum titer reduction by soluble antigens. The Lattes crust technique involves direct reaction of known indicator cells with antibodies present in dried bloodstain crusts.

NODIA

76. (B) It is boiled for 10 minutes to heat-inactivate enzymes.
Freshly collected saliva contains active endogenous enzymes, including starch-degrading amylases and various proteolytic enzymes that rapidly degrade antibody reagents during serological testing. Boiling the saliva sample in a boiling water bath for 10 minutes heat-denatures

these destructive enzymes while preserving stable heat-resistant glycoprotein ABO group substances, ensuring accurate results during absorption-inhibition assays.

77. (A) Codominance
In the MNSs blood group system, M and N alleles exhibit autosomal codominance. Inheriting an M allele from one parent and an N allele from the other results in simultaneous expression of both glycophorin A structural variants on erythrocyte membranes. Heterozygous MN individuals possess both M and N cell surface antigens, reacting positive with anti-M and anti-N antisera.

78. (A) II, IV, I, III
The historical timeline of blood group discoveries began with Karl Landsteiner discovering the ABO system in 1900. Landsteiner and Levine discovered the MNSs system in 1927. Landsteiner and Wiener subsequently identified the Rh system in 1940. Finally, characterization of the complex Human Leukocyte Antigen system occurred later in the mid-1950s, establishing the historical order II, IV, I, III.

79. (D) D-galactose
Biosynthesis of the human group B blood antigen is mediated by UDP-galactose:beta-D-galactosyl-1,4-N-acetyl-D-glucosaminide alpha-1,3-galactosyltransferase encoded by the functional B allele. This glycosyltransferase enzyme catalyzes the covalent attachment of a terminal monosaccharide, D-galactose, via an alpha-1,3-linkage to the subterminal galactose residue of precursor H antigen, conferring group B antigenic specificity to erythrocyte membrane glycolipids.

80. (C) Spontaneous agglutination of red cells with all antisera.
Panagglutination refers to an abnormal serological condition where red blood cells agglutinate non-specifically when mixed with all testing antisera and normal human sera. This non-specific clumping often occurs due to microbial enzyme exposure, such as bacterial neuraminidase cleaving surface sialic acid to expose hidden T-antigens, causing universal red cell cross-reactivity and obscuring valid blood grouping.

81. (B) The reciprocal of the highest serum dilution producing visible agglutination.
In serological assays, antibody titer measures the concentration of specific antibodies present in a serum sample. Titer is determined by performing serial two-fold dilutions of serum and reacting each dilution with target red blood cells. The titer value is expressed as the reciprocal of the highest serum dilution that still yields macroscopic or microscopic cell agglutination.

82. (D) I, II and III
Secretor individuals possessing the dominant Se allele express functional fucosyltransferase in exocrine glands throughout the body. Consequently, soluble A, B, and H blood group glycoproteins are actively synthesized and secreted into multiple body fluids, including saliva, seminal plasma, gastric juices, perspiration, vaginal secretions, and tears, making all three fluids reliable for secretor testing.

83. (A) The test is invalid due to substrate interference.
In forensic absorption-elution testing, negative substrate controls consisting of unstained carrier material surrounding the bloodstain are tested in parallel. If the substrate control yields positive agglutination with indicator cells, non-specific antibody absorption or chemical substrate interference is occurring, rendering the entire serological analysis invalid and completely uninterpretable for forensic casework.

84. (C) Agglutination with both Anti-A and Anti-B.
Mixing liquid blood from group A and group B individuals creates a chimeric sample containing red blood cells carrying A antigens alongside red blood cells carrying B antigens. When tested using standard forward grouping, commercial anti-A antiserum agglutinates the group A cells, while anti-B antiserum agglutinates the group B cells, producing agglutination in both tests.

85. (A) P-3, Q-4, R-1, S-2
Standard genetics terminology provides foundational distinctions in immunogenetics. Phenotype represents observable physical or biochemical traits expressed by an organism. Genotype defines the underlying inherited genetic constitution. An allele is an alternative functional form of a gene, while locus denotes the specific physical location or structural address of a gene on a chromosome.

Click Here to Buy book on Flipkart

III. Ethylene Diamine Tetraacetic Acid (EDTA) acts to directly lyse the nuclear envelope.

Which of the above statement(s) is/are correct?
(A) I and II only
(B) I and III only
(C) II and III only
(D) I, II, and III

8. In magnetic bead-based DNA extraction, which is increasingly automated in forensic laboratories, the binding of DNA to the silica-coated magnetic beads typically occurs under which of the following conditions?
(A) High pH and low salt concentration
(B) Low pH and low salt concentration
(C) Presence of chaotropic salts and low pH
(D) High temperature and presence of reducing agents

9. FTA paper is widely used for the collection and storage of reference blood samples. Which of the following statements correctly describes a property of FTA paper?
(A) It strictly requires immediate sample storage at -20 degrees Celsius following field collection
(B) DNA must be organically extracted using phenol-chloroform before any downstream PCR can occur
(C) It is primarily designed for capturing and preserving volatile organic compounds in toxicology
(D) It contains chemicals that lyse cells, denature proteins, and protect DNA from degradation

10. Read the following statements carefully and select the correct option:
Assertion (A): Before extracting DNA from compact bone fragments, the bone is typically ground into a fine powder and incubated with high concentrations of EDTA.
Reason (R): EDTA acts as a decalcifying agent that chelates calcium ions, helping to break down the bone matrix and release the cellular material.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

11. Which of the following pairs concerning forensic DNA sources is incorrectly matched?
(A) Plucked hair with intact root - Good source of nuclear DNA
(B) Mature red blood cells - Primary source of nuclear DNA in blood
(C) Naturally shed hair shaft - Primary source of mitochondrial DNA (mtDNA)
(D) Buccal swab - Good source of epithelial cell nuclear DNA

NODIA

12. "Touch DNA" refers to trace biological material left behind when a person handles an object. The primary cellular component recovered in a touch DNA sample is:
(A) Red blood cells
(B) Shed epidermal skin cells
(C) Sebaceous gland secretions
(D) Extracellular free-floating DNA

13. Spectrophotometric quantification assesses the purity of a DNA extract by measuring the absorbance of ultraviolet light. A pure DNA sample will typically exhibit a 260/280 nm absorbance ratio of approximately:
(A) 1.0 to 1.2
(B) 1.5 to 1.6
(C) 1.8 to 2.0
(D) 2.2 to 2.4

14. What is the main advantage of using fluorometric quantification over standard UV spectrophotometry in forensic DNA analysis?
(A) Fluorometry directly sequences single-stranded DNA fragments during the quantitative assay process
(B) Fluorometry provides highly selective human-specific quantification, which standard UV methods cannot
(C) Fluorometry specifically measures double-stranded DNA, minimizing interference from contaminants
(D) Fluorometry operates independently of calibration standards and does not require reference curves

15. Humic acid is a known PCR inhibitor frequently encountered in forensic casework. From which of the following evidence types is humic acid most likely to be co-extracted?
(A) Bloodstains on denim fabric
(B) Semen stains on polyester bedsheets
(C) Saliva on a glass bottle
(D) Skeletal remains buried in soil

CHAPTER 16
DNA Extraction and PCR Basics

1. The general workflow for forensic DNA profiling follows a specific sequence of standard laboratory procedures. Which of the following is the correct order of these procedures?
I. Polymerase Chain Reaction (PCR) amplification
II. DNA Extraction
III. Capillary Electrophoresis and Data Analysis
IV. Sample Collection and Screening
V. DNA Quantification
(A) IV, II, I, V, III
(B) IV, II, V, I, III
(C) II, IV, V, I, III
(D) IV, V, II, I, III

2. In a forensic biology laboratory, standard precautions are implemented to prevent DNA contamination. Which of the following practices is considered incorrect for minimizing contamination?
(A) Using disposable, sterile consumables and aerosol-resistant pipette tips
(B) Employing a unidirectional workflow from pre-PCR to post-PCR areas
(C) Regular decontamination of work surfaces with 10% bleach followed by ethanol
(D) Processing evidence samples and reference samples in the same workspace simultaneously

3. During the traditional organic extraction of DNA, a mixture of phenol, chloroform, and isoamyl alcohol is used. What is the primary function of chloroform in this mixture?
(A) It increases the density of the organic phase to ensure distinct layer separation
(B) It reduces the surface tension to prevent foaming
(C) It denatures the DNA to allow separation of strands
(D) It precipitates the DNA out of the aqueous solution

4. Chelex-100 is frequently used in forensic laboratories for extracting DNA from small biological samples. The fundamental mechanism by which Chelex protects DNA from degradation during the boiling extraction process is:
(A) By enzymatically digesting endonucleases present in the sample
(B) By lowering the pH of the solution to inhibit bacterial growth
(C) By binding to polyvalent metal ions like magnesium, which are necessary cofactors for DNases
(D) By forming a protective lipid bilayer around the DNA molecules

5. What is the most appropriate method for preserving bloodstained clothing prior to forensic examination?
(A) Air-drying away from direct heat and sunlight, then packing in a porous paper bag
(B) Packing the wet clothing inside a sealed plastic container and storing at room temp
(C) Immediate freezing of the wet clothing within a hermetically sealed glass vial
(D) Washing the stain using normal saline and transferring washings to a glass tube

6. Consider the following statements regarding differential extraction in sexual assault cases:
Statement I: Differential extraction relies on the fact that sperm cell membranes contain disulfide bonds that are highly resistant to lysis by SDS and Proteinase K alone.
Statement II: Dithiothreitol (DTT) is added in the first step of differential extraction to selectively break open the epithelial cells.
Which of the following is correct?
(A) Both Statement I and Statement II are true
(B) Both Statement I and Statement II are false
(C) Statement I is true but Statement II is false
(D) Statement I is false but Statement II is true

7. Consider the following statements about cell lysis in DNA extraction:
I. Proteinase K is an enzyme used to digest histone proteins and nucleases.
II. Sodium Dodecyl Sulfate (SDS) is a detergent that ruptures cell membranes and denatures proteins.

NODIA

86. (D) Group B
Population genetics studies demonstrate distinct geographical variations in ABO allele distribution. Across the native populations of the Indian subcontinent, blood group B exhibits the highest overall phenotypic frequency, typically comprising approximately 30 to 40 percent of individuals. Group O is second most prevalent, followed by group A, while group AB remains least common.

87. (B) Mother is AB, Child is O
Under Mendelian inheritance laws, a mother with group AB possesses A and B alleles, obligatorily passing one to every offspring. A child with group O requires inheriting two silent O alleles, one from each parent. Because an AB mother cannot transmit an O allele, mothering a group O child is impossible, conclusively excluding maternity.

88. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Severe environmental exposure of forensic bloodstains degrades cell membrane carbohydrate antigens. If A or B antigens undergo conformational damage or enzymatic cleavage, testing antisera fail to bind, preventing agglutination. Because group O is characterized by an absence of agglutination with anti-A and anti-B antisera, degraded stains carrying damaged antigens falsely present as blood group O.

89. (D) Agglutination with Anti-A and Anti-B
Individuals with the A2B subgroup possess both A and B genes, expressing B antigen alongside the weaker A2 subgroup antigen on their erythrocytes. Standard monoclonal or polyclonal forward grouping antisera (anti-A and anti-B) contain high antibody concentrations capable of binding both A2 and B epitopes, producing macroscopic agglutination with both anti-A and anti-B reagents.

90. (A) Higher primates like chimpanzees
Higher primates, particularly chimpanzees (Pan troglodytes), express erythrocyte surface antigens and natural serum antibodies chemically and immunologically analogous to the human ABO blood group system. Early serological testing showed that chimpanzees possess A and O antigens that cross-react strongly with human antisera, complicating species differentiation in historical forensic investigations before species-specific precipitin tests were established.

www.nodia.in

Downloaded from www.pdf.tube

16. Consider the following statements about Real-Time PCR quantification:
I. It allows the monitoring of the PCR reaction during the exponential phase of amplification.
II. It requires a fluorescent probe or dye to measure the accumulation of the DNA product.
III. It can determine the amount of human-specific DNA present in a mixed-species sample.
IV. It only provides a qualitative result, indicating whether DNA is present or absent.
Which of the above statement(s) is/are correct?
(A) I, II, and III
(B) I, II, and IV
(C) II, III, and IV
(D) I, III, and IV

17. In a forensic laboratory, a Real-Time PCR quantification kit uses two different sized target amplicons (e.g., a small target of 80 bp and a large target of 214 bp). If the quantification result shows a high concentration for the small target but a very low concentration for the large target, what does this indicate about the sample?
(A) The sample is heavily contaminated with PCR inhibitors
(B) The human DNA in the sample is highly degraded
(C) The sample contains a mixture of human and bacterial DNA
(D) The sample contains exclusively mitochondrial DNA

18. Match the common PCR inhibitors listed in List I with their typical forensic sources in List II:
List I
P. Heme
Q. Indigo dye
R. Humic acid
S. Melanin
List II
1. Soil/Dirt
2. Denim clothing
3. Blood
4. Hair
(A) P-3, Q-2, R-1, S-4
(B) P-2, Q-3, R-1, S-4
(C) P-3, Q-1, R-2, S-4
(D) P-4, Q-2, R-1, S-3

19. Forensic scientists use various methods to mitigate the effects of PCR inhibitors in a DNA extract. Which of the following is NOT a standard laboratory strategy for overcoming PCR inhibition?
(A) Significantly increasing the amount of input DNA template
(B) Diluting the crude DNA extract to effectively lower the total concentration of inhibitors
(C) Supplementing the reaction mixture with Bovine Serum Albumin to prevent enzyme binding
(D) Performing additional purification of the extract using specialized silica spin columns

NODIA

20. In solid-phase extraction using silica, chaotropic salts are essential. Which of the following is a commonly used chaotropic salt in DNA extraction buffers?
(A) Sodium chloride
(B) Potassium chloride
(C) Guanidinium thiocyanate
(D) Magnesium sulfate

21. The polymerase chain reaction (PCR), a revolutionary technique in molecular biology and forensic science, was invented by which of the following scientists in 1983?
(A) Kary Mullis
(B) Alec Jeffreys
(C) Frederick Sanger
(D) James Watson

22. Taq polymerase is the most widely used thermostable enzyme in forensic PCR. It was originally isolated from Thermus aquaticus, a bacterium found in:
(A) Hydrothermal vent ecosystems located in deep oceanic trenches
(B) Hypersaline lakes and inland salt flats with high alkalinity
(C) Permafrost ice sheets located within remote Arctic regions
(D) Geothermal hot springs located in Yellowstone National Park

23. In a standard PCR reaction, magnesium chloride ($MgCl_2$) is a critical component of the buffer. What is the primary role of the magnesium ions?
(A) They act as a buffer to maintain a constant pH of 8.3
(B) They serve as a cofactor for the Taq DNA polymerase enzyme
(C) They denature the double-stranded DNA template
(D) They prevent the degradation of dNTPs

separation
3. Uses chaotropic salts for DNA adsorption
4. Employs a boiling step with an ion-exchange resin

(A) P-2, Q-4, R-3, S-1
(B) P-3, Q-4, R-2, S-1
(C) P-2, Q-1, R-3, S-4
(D) P-4, Q-2, R-1, S-3

41. Which of the following is considered the least invasive and most commonly preferred method for collecting a reference DNA sample from a living suspect?
(A) Drawing 5 ml of fresh venous blood via venipuncture
(B) Surgical extraction of an intact molar tooth specimen
(C) Plucking 10 to 15 hair follicles directly from the scalp
(D) Swabbing the oral buccal mucosa

42. Proper chain of custody and packaging are vital for forensic evidence. Which of the following actions is strictly prohibited when packaging biological evidence for DNA analysis?
(A) Sealing a wet, blood-soaked shirt in a plastic bag to prevent fluid leakage
(B) Placing dried blood swabs in a paper envelope
(C) Labeling the package with the case number, date, and collecting officer's signature
(D) Storing liquid blood reference samples in EDTA vacutainers under refrigeration

43. DNA analysis laboratories often use UV irradiation lamps in their biological safety cabinets. The primary purpose of exposing the workspace to UV light before setting up a PCR is:
(A) Activating photosensitive fluorescent dyes contained within standard extraction reagent mixtures
(B) Cross-linking contaminating DNA via thymine dimers to prevent amplification
(C) Pre-heating the laminar airflow cabinet work surface to reach the optimal annealing temperature
(D) Neutralizing ambient static electrical charges that typically attract airborne dust particles

44. After centrifuging a sample mixed with phenol-chloroform-isoamyl alcohol, the mixture separates into layers. Where is the aqueous layer containing the purified DNA located?
(A) The bottom layer
(B) The top layer
(C) The middle interface (buffy coat)
(D) Mixed evenly throughout the suspension

45. In Chelex-100 extraction, what happens if the Chelex beads are accidentally transferred into the PCR amplification tube along with the DNA extract?
(A) Chelex chelates essential magnesium ions, inhibiting PCR
(B) PCR efficiency increases because Chelex stabilizes the Taq polymerase enzyme during thermal cycling
(C) The beads act as non-specific initiation sites, leading to extensive mispriming and unintended amplification
(D) The PCR process proceeds completely normally because Chelex remains chemically inert at high temperatures

46. Read the following statements carefully and select the correct option:
Assertion (A): In silica-based DNA extraction, after the DNA binds to the silica matrix, it is washed with a buffer containing ethanol.
Reason (R): Ethanol keeps the DNA precipitated and bound to the silica while washing away salts, proteins, and cellular debris.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

47. When performing an FTA card punch for direct PCR, the punch must be washed before amplification. Which of the following is true regarding this washing step?
(A) It is thoroughly washed using concentrated hydrochloric acid to digest paper fibers and release DNA
(B) It is washed with an organic phenol solution to extract DNA into a liquid phase suitable for quantification
(C) It is washed repeatedly with boiling deionized water to dissolve the underlying cellulose paper matrix
(D) Washed with purification reagent and buffer to remove inhibitors while keeping DNA bound

Click Here to Buy book on Amazon

samples gathered from multiple suspects within a single reaction

33. Reverse transcription PCR (RT-PCR) is utilized in forensic science primarily for the identification of body fluids. In RT-PCR, the starting template material that is reverse-transcribed into complementary DNA (cDNA) is:
(A) Mitochondrial DNA
(B) Messenger RNA (mRNA)
(C) Genomic DNA
(D) Transfer RNA (tRNA)

34. Consider the following statements regarding PCR controls:
Statement I: A positive amplification control consists of a known DNA template, such as cell line 9947A, added to the master mix to ensure that the PCR reagents are working correctly.
Statement II: A negative amplification control contains all the PCR reagents but no DNA template, to check for contamination in the master mix.
Which of the following is correct?
(A) Both Statement I and Statement II are true
(B) Both Statement I and Statement II are false
(C) Statement I is true but Statement II is false
(D) Statement I is false but Statement II is true

35. In modern forensic laboratories, Post-PCR analysis is predominantly conducted using Capillary Electrophoresis (CE). The separation medium inside the capillary tube that allows for the size-based separation of amplified DNA fragments is typically:
(A) A liquid polymer solution (e.g., POP-4)
(B) A solid cross-linked agarose gel matrix
(C) A high-purity crystalline silica matrix
(D) A continuous capillary stream of pure water

36. When performing standard agarose gel electrophoresis to check for the presence of amplified DNA products, the DNA fragments migrate towards the positive electrode (anode) because:
(A) DNA molecules possess a net positive charge due to the nitrogenous bases
(B) The agarose matrix applies an electrostatic pull on the neutral DNA molecules
(C) DNA molecules possess a net negative charge due to the phosphate backbone
(D) The tracking dye covalently binds to the DNA, imparting a negative charge

37. In a genetic analyzer used for STR typing, how are the different PCR products detected as they pass the detection window of the capillary?
(A) By laser excitation of fluorescent dyes on primers, detecting emitted light via CCD
(B) Through continuous direct spectrophotometric absorption of ultraviolet light calibrated at 260 nm
(C) By incorporation of radioactive isotope labels into dNTPs detected using an internal Geiger counter
(D) By continuously measuring micro-changes in electrical resistance as fragments clear the capillary exit

38. When troubleshooting a failed PCR reaction, the observation of a thick band of very small molecular weight (usually below 50 bp) on an agarose gel, accompanied by weak or absent target bands, most likely indicates:
(A) DNA degradation
(B) The presence of a PCR inhibitor
(C) Incomplete denaturation of the template
(D) Primer-dimer formation

39. Consider the following statements regarding "Rapid DNA" technology:
I. It integrates DNA extraction, amplification, and separation into a single automated instrument.
II. It is capable of generating a full STR profile from a buccal swab in less than two hours.
III. It completely eliminates the need for any chemical reagents or primers.
IV. It is increasingly deployed in decentralized locations like police stations for quick identification.
Which of the above statement(s) is/are correct?
(A) I, II, and IV
(B) II, III, and IV
(C) I, II, and III
(D) I, III, and IV

NODIA

40. Match the DNA extraction method listed in List I with its core operational principle or characteristic component in List II:
List I
P. Organic Extraction
Q. Chelex Extraction
R. Silica-based Extraction
S. Differential Extraction
List II
1. Uses DTT to separate sperm fractions
2. Employs phenol and chloroform for phase

free of human DNA
(D) To measure the amount of male-specific (Y-chromosome) DNA in the sample

56. Heme from blood is a potent PCR inhibitor. Its primary mechanism of inhibiting the PCR reaction is by:
(A) Chemically degrading single-stranded template DNA molecules
(B) Forming irreversible covalent bonds with forward primers
(C) Inactivating Taq DNA polymerase directly
(D) Chelating all essential magnesium cofactors in the buffer

57. Bovine Serum Albumin (BSA) is commonly added to the forensic PCR master mix. What is its main function?
(A) It serves as an alternative non-human template for competitive amplification
(B) It supplies key biochemical nutrients that protect DNA template integrity
(C) It acts as a surrogate enzyme when primary Taq polymerase undergoes denaturation
(D) Binds PCR inhibitors like hematin or humic acid

58. Consider the following specific steps of the PCR thermal cycling process:
1. Primer Annealing
2. Initial Denaturation
3. Final Extension
4. Denaturation
5. Primer Extension

Which of the following options represents the correct chronological sequence for one complete cycle?
(A) 2, 4, 1, 5, 3
(B) 2, 1, 5, 4, 3
(C) 4, 1, 5, 2, 3
(D) 2, 5, 1, 4, 3

59. Consider the following components used in enzymatic reactions:
I. DNA Template
II. DNA Ligase
III. Deoxynucleotide triphosphates (dNTPs)
IV. Oligonucleotide Primers

Which of the above components are essential for an in vitro Polymerase Chain Reaction (PCR)?
(A) I, II, and III
(B) I, III, and IV
(C) II, III, and IV
(D) I, II, III, and IV

60. Match the PCR component/concept listed in List I with its description in List II:
List I
P. Forward and Reverse Primers
Q. Amplicon
R. Taq Polymerase
S. Thermocycling
List II
1. The process of rapidly changing temperatures
2. Flank the target region to be amplified
3. The specific final DNA product generated by PCR
4. The enzyme responsible for synthesizing new DNA strands
(A) P-2, Q-3, R-4, S-1
(B) P-3, Q-2, R-1, S-4
(C) P-2, Q-1, R-4, S-3
(D) P-4, Q-3, R-2, S-1

61. Identify the incorrect pair regarding thermostable enzymes and their properties.
(A) Pfu polymerase - Produces 'A-tailed' products for STR cloning
(B) Taq polymerase - Adds a non-template adenine nucleotide to the 3' end of amplicons
(C) Pfu polymerase - Possesses proofreading 3' to 5' exonuclease activity during extension
(D) Taq polymerase - Thermostable enzyme originally isolated from Thermus aquaticus

62. In the design of oligonucleotide primers for forensic DNA amplification, the typical length of the primer is usually:
(A) 5 to 10 base pairs
(B) 18 to 30 base pairs
(C) 50 to 100 base pairs
(D) 150 to 200 base pairs

63. The standard PCR buffer contains Tris-HCl. The purpose of Tris-HCl is to maintain the reaction pH at an optimum level for Taq polymerase activity, which is approximately:
(A) pH 5.0 - 5.5
(B) pH 6.5 - 7.0
(C) pH 8.0 - 8.5
(D) pH 10.0 - 10.5

64. If the concentration of magnesium chloride ($MgCl_2$) in a PCR master mix is significantly lower than optimal, what is the most likely consequence?
(A) The reaction produces extensive non-specific amplification and abundant primer-dimer complexes

Downloaded from www.pdf.tube

48. During the differential extraction of a vaginal swab containing both epithelial cells and spermatozoa, what is the role of Dithiothreitol (DTT)?
(A) It is added during the initial step to selectively break down epithelial cell outer membranes
(B) It acts primarily to neutralize the naturally acidic biochemical environment of vaginal swabs
(C) It breaks disulfide bonds in sperm membranes during the second lysis step
(D) It functions mainly as a differential indicator stain for visualizing sperm heads under microscopy

49. When extracting DNA from aged skeletal remains, forensic anthropologists and biologists must contend with both degradation and inhibition. Calcium is a major inhibitor found in bone extracts. Which chemical is primarily used to chelate this calcium during extraction?
(A) Phenol
(B) EDTA
(C) Chloroform
(D) Isopropanol

50. Consider the following statements regarding DNA extraction from hair:
I. A naturally shed hair shaft generally lacks sufficient high-quality nuclear DNA for standard STR profiling.
II. Mitochondrial DNA (mtDNA) extraction and sequencing are the preferred methods for hair shafts.
III. The telogen phase hair root yields the highest amount of nuclear DNA compared to an anagen phase hair root.
Which of the above statement(s) is/are correct?
(A) I and II only
(B) I and III only
(C) II and III only
(D) I, II, and III

51. When a forensic analyst refers to "Low Template DNA" (LT-DNA), usually associated with touch DNA, they are typically referring to samples that contain less than:
(A) 1 nanogram (ng) of template DNA
(B) 100 picograms (pg) of template DNA
(C) 1 microgram (µg) of template DNA
(D) 10 nanograms (ng) of template DNA

52. DNA quantification is a mandatory step before STR amplification in forensic casework. Which of the following is an INCORRECT reason for quantifying DNA?
(A) Adding too much DNA can lead to off-scale peaks and interpretation difficulties like pull-up
(B) Adding too little DNA can result in allele drop-out or partial profiles
(C) Quantification determines the exact sequence of alleles present at every locus
(D) Standardized input of DNA (usually 0.5 to 1.0 ng) ensures optimal and reproducible STR profiles

NODIA

53. If a forensic DNA extract is contaminated with a significant amount of RNA, how will this affect spectrophotometric quantification at 260 nm?
(A) Falsely elevate DNA concentration because RNA absorbs UV at 260 nm
(B) Have no effect on the quantification measurement because RNA does not absorb light in the UV spectrum
(C) Falsely lower the measured DNA concentration by interfering with photon absorption in the spectrometer
(D) Render the solution completely opaque, preventing any UV light from passing through the quartz cuvette

54. Commercial DNA quantification kits used in forensic science employ TaqMan probe technology. The fluorescence signal is generated when:
(A) The probe binds covalently within the minor groove of target double-stranded DNA molecules
(B) The fluorophore absorbs thermal energy during denaturation cycles and directly emits light
(C) The quencher molecule is chemically reduced upon binding directly to single-stranded template DNA
(D) Taq polymerase cleaves the probe, separating fluorophore from quencher

55. In a Real-Time PCR quantification assay, what is the purpose of the Internal Positive Control (IPC)?
(A) To provide a standard curve for calculating DNA concentration
(B) To determine if PCR inhibitors are present in the sample extract
(C) To confirm that the extraction reagents are

during thermal cycling

24. Which of the following best describes the role of deoxynucleotide triphosphates (dNTPs) in a PCR reaction?
(A) They supply the primary chemical energy required to denature double-stranded DNA templates
(B) They act as short oligonucleotide primer sequences required to initiate enzymatic synthesis
(C) They serve as building blocks incorporated into the newly synthesized DNA strand
(D) They bind directly to single-stranded DNA templates to prevent secondary structure reannealing

25. Consider the following rules for designing primers in forensic DNA multiplexes:
I. Primers should ideally have a GC content of 40-60%.
II. Primers should have complementary sequences at their 3' ends to prevent primer-dimer formation.
III. The melting temperatures (Tm) of forward and reverse primers should be similar.
Which of the above statement(s) is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

26. A thermal cycler alters temperatures to facilitate the different stages of PCR. Select the correct sequence of temperatures that typically correspond to Denaturation, Annealing, and Extension respectively.
(A) 95°C, 60°C, 72°C
(B) 72°C, 95°C, 60°C
(C) 60°C, 72°C, 95°C
(D) 95°C, 72°C, 60°C

27. The denaturation step in a standard PCR cycle involves:
(A) Rapidly cooling the reaction mixture to enable oligonucleotide primers to anneal to template DNA
(B) Heating the reaction to 94–95°C to separate the double-stranded DNA template
(C) Raising the reaction temperature to 72°C to activate the thermostable polymerase enzyme
(D) Promoting the enzymatic digestion of residual protein contaminants present in the mix

28. Read the following statements carefully and select the correct option:
Assertion (A): If the annealing temperature in a PCR cycle is set too low, non-specific DNA amplification and secondary products may occur.
Reason (R): Low temperatures allow primers to bind to DNA sequences that are not perfectly complementary, leading to non-specific extension.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

29. During the extension (or elongation) phase of PCR, the optimum temperature for standard Taq polymerase activity is generally set at:
(A) 50°C
(B) 60°C
(C) 72°C
(D) 95°C

30. Assuming 100% efficiency in a standard PCR reaction, if you begin with exactly 1 copy of a double-stranded DNA target molecule, how many copies will theoretically be present after 30 cycles?
(A) Approximately 1,000
(B) Approximately 1 million
(C) Approximately 1 billion
(D) Approximately 1 trillion

31. Modern thermal cyclers achieve rapid and precise temperature changes primarily through the use of which technology?
(A) Rapidly circulating fluid water baths
(B) Focused infrared laser heating arrays
(C) Controlled microwave radiation emitters
(D) Peltier thermoelectric cooling blocks

32. Multiplex PCR is a foundational technique in forensic DNA profiling. It is defined as:
(A) The sequential addition of multiple distinct thermostable polymerase enzymes within one reaction tube
(B) Running identical PCR amplification samples across multiple thermal cyclers to verify reproducibility
(C) Simultaneous amplification of multiple DNA loci in one tube using distinct primer sets
(D) Combining and amplifying target DNA

Click Here to Buy book on Flipkart

(B) Double-stranded DNA template strands fail to undergo complete denaturation at 95°C
(C) Taq polymerase activity drops significantly, yielding little or no product
(D) Amplified PCR products exhibit abnormally rapid migration during capillary electrophoresis

65. During standard forensic PCR of human genomic DNA, the duration of the denaturation step at 94-95°C in each cycle typically lasts for:
(A) 10 to 20 seconds
(B) 30 to 60 seconds
(C) 5 to 10 minutes
(D) 15 to 20 minutes

66. The melting temperature (Tm) of a primer is the temperature at which half of the DNA strands are in the double-helical state and half are random coils. The annealing temperature chosen for a PCR reaction is generally:
(A) 10°C to 15°C above the lowest Tm of the primers
(B) Exactly equal to the highest Tm of the primers
(C) Independent of the primer Tm and fixed at 50°C
(D) 3°C to 5°C below the lowest Tm of the primers

67. Read the following statements carefully and select the correct option:
Assertion (A): A final extension step at 60°C or 72°C for 5-15 minutes is usually included at the end of a forensic multiplex STR amplification.
Reason (R): It ensures that the Taq polymerase has sufficient time to complete the addition of a non-template adenine (A) nucleotide to the 3' end of all amplicons, promoting uniform fragment sizes.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

68. Under theoretically perfect conditions, the amplification in PCR is exponential. If you start with 10 copies of a target DNA sequence, how many copies will be generated after just 3 thermal cycles?
(A) 30
(B) 40
(C) 80
(D) 100

69. The Peltier effect is utilized in modern forensic thermal cyclers to achieve rapid temperature cycling. Which of the following statements best describes the Peltier effect?
(A) Heat absorption or release at the junction of two conductors when electric current flows
(B) Rapid thermal generation caused by friction from microwave agitation of polar water molecules
(C) Heat distribution occurring primarily through dynamic fluid convection currents within liquid baths
(D) Thermal energy emission produced by high-temperature incandescence of tungsten heating filaments

70. Consider the following statements regarding the technical challenges of designing a multiplex PCR kit for forensic identification:
I. Ensuring that primers for different loci do not bind to each other (primer-dimer formation).
II. Balancing the concentration of primers so that all loci amplify evenly.
III. Ensuring that amplicons of different loci using the same dye color have overlapping size ranges.
Which of the above statement(s) is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

71. In real-time quantitative PCR using TaqMan probes, which sequence of events leads to the generation of a fluorescent signal?
(A) Denaturation → Probe binding → Polymerase extension → Probe cleavage → Fluorescence
(B) Denaturation → Primer extension → Probe binding → Probe cleavage → Fluorescence
(C) Probe binding → Denaturation → Polymerase extension → Fluorescence → Probe cleavage
(D) Denaturation → Polymerase extension → Fluorescence → Probe binding → Probe cleavage

72. In reverse transcription PCR (RT-PCR) used for mRNA-based body fluid identification, the

Downloaded from www.pdf.tube

9. (D) It contains chemicals that lyse cells, denature proteins, and protect DNA from degradation
FTA paper is an absorbent matrix chemically treated with denaturants, chelating agents, and free radical scavengers. Upon sample application, these chemicals instantly lyse cell membranes, denature cellular proteins, and inactivate nucleases or bacterial growth. This preservation mechanism stabilizes genomic DNA directly on the cellulose paper matrix, permitting long-term room temperature storage without requiring liquid extraction.

10. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Bone tissue consists of an inorganic hydroxyapatite matrix bound to organic collagen fibers that trap osteocytes. Grinding the bone increases the surface area for enzymatic and chemical action. Concentrated EDTA acts as a powerful decalcifying agent by chelating calcium ions in hydroxyapatite, dissolving the hard matrix and exposing trapped osteocyte cells for effective subsequent lysis and DNA recovery.

11. (B) Mature red blood cells - Primary source of nuclear DNA in blood
Human mature red blood cells undergo enucleation during maturation and lack nuclei along with mitochondria, making them completely devoid of nuclear DNA. The primary source of genomic nuclear DNA recovered from whole blood samples consists of nucleated white blood cells. Plucked hairs with intact roots, naturally shed hair shafts, and buccal swabs contain suitable cellular sources of nucleic acids.

12. (B) Shed epidermal skin cells
Touch DNA refers to micro-quantities of biological material transferred when an individual handles surfaces or objects. The primary cellular component recovered from touch DNA evidence comprises sloughed keratinocytes and shed epidermal skin cells from the outer stratum corneum. These corneocytes contain usable nuclear DNA fragments, whereas sebaceous secretions and extracellular components contribute negligible amounts of amplifiable genomic DNA.

13. (C) 1.8 to 2.0
Spectrophotometric measurement evaluates nucleic acid purity by comparing UV absorbance at 260 nanometers, where nucleic acids absorb, and 280 nanometers, where proteins absorb. Pure double-stranded DNA exhibits an absorbance ratio between 1.8 and 2.0. Ratios significantly below 1.8 indicate protein or phenol contamination, while ratios above 2.0 indicate residual RNA presence within the extracted sample mixture.

NODIA

14. (C) Fluorometry specifically measures double-stranded DNA, minimizing interference from contaminants
Fluorometric quantification uses intercalating fluorescent dyes that selectively bind to intact double-stranded DNA. Unlike UV spectrophotometry, which measures total light absorbance from double-stranded DNA, single-stranded DNA, RNA, free nucleotides, and aromatic contaminants, fluorometry measures only functional double-stranded target molecules. This specificity avoids overestimating amplifiable DNA concentrations in compromised or degraded forensic samples.

15. (D) Skeletal remains buried in soil
Humic acid is an organic macromolecule produced by the natural decomposition of vegetation in topsoil. When forensic skeletal remains or buried biological evidence are recovered from soil environments, humic acid co-extracts alongside human DNA. Humic substances bind to DNA molecules and inactivate Taq polymerase, acting as potent inhibitors during subsequent enzymatic PCR amplification processes.

16. (A) I, II, and III
Real-Time quantitative PCR tracks target DNA amplification continuously during the exponential phase using fluorescent probes or dyes. Primer sequences engineered for human-specific DNA targets enable accurate quantification of human template DNA within mixed-species samples. The technique provides precise quantitative measurement of starting DNA copy numbers rather than merely qualitative detection, confirming statement IV is incorrect.

17. (B) The human DNA in the sample is highly degraded
Dual-target qPCR assays incorporate both short and long DNA target amplicons to assess sample degradation. Enzymatic or environmental degradation breaks DNA strands into smaller fragments. Smaller fragments remain intact enough to yield high amplification signals for

(D) MPS instruments are generally cheaper, faster, and require less complex bioinformatics software than CE

80. Match the forensic DNA laboratory equipment listed in List I with its primary function in List II:

List I

P. Microcentrifuge
Q. Thermal Cycler
R. Spectrophotometer
S. Genetic Analyzer

List II

1. Amplifies specific DNA regions via temperature variations
2. Separates cell debris from DNA extract using centrifugal force
3. Separates and detects fluorescently labeled DNA fragments
4. Measures the absorbance of light to quantify DNA purity

(A) P-2, Q-1, R-4, S-3
(B) P-1, Q-2, R-3, S-4
(C) P-4, Q-3, R-2, S-1
(D) P-2, Q-4, R-1, S-3

81. In forensic evidence handling, establishing the "chain of custody" is paramount. Chain of custody primarily refers to:
(A) Establishing physical barricades and perimeter security zones around active crime scene locations
(B) Documentation tracking the seizure, custody, transfer, and disposition of evidence
(C) Mandatory administrative protocols requiring evidence storage within reinforced steel lockboxes
(D) Standard operating procedures specifying sequential DNA extraction steps carried out by analysts

82. Which of the following is the most appropriate long-term storage condition for reference blood samples collected on FTA cards to ensure maximum DNA stability in a forensic lab?
(A) Immersed continuously in buffered 10% formalin solutions stored at room temperature
(B) Kept completely unprotected on open laboratory benchtops under ambient lighting
(C) Frozen directly submerged within physiological saline solutions held at -80°C
(D) Stored in paper envelopes with desiccant at room temp or 4°C

83. Consider the following statements regarding laboratory design to prevent DNA contamination:
Statement I: A forensic DNA laboratory must maintain a unidirectional workflow, proceeding from the post-PCR analysis area back to the pre-PCR extraction area to ensure cleanliness.
Statement II: Dedicated equipment and pipettes must be kept separate for extraction, PCR setup, and post-PCR activities.
Which of the following is correct?
(A) Both Statement I and Statement II are true
(B) Both Statement I and Statement II are false
(C) Statement I is true but Statement II is false
(D) Statement I is false but Statement II is true

84. During organic and solid-phase extractions, Proteinase K is utilized. The optimal temperature for Proteinase K enzymatic activity during cell lysis is typically:
(A) 4°C
(B) 37°C
(C) 56°C
(D) 95°C

85. In an organic DNA extraction workflow, after the aqueous layer is separated, absolute ethanol or isopropanol is often added. What is the fundamental purpose of this step?
(A) To precipitate DNA from aqueous solution
(B) To dissolve and extract any remaining lipid membrane residues
(C) To neutralize the acidic pH of the aqueous extraction buffer
(D) To solubilize and wash away residual trace phenol molecules

86. In the Chelex extraction method, the sample is typically boiled at 100°C for 8 minutes. What is the primary reason for this boiling step?
(A) To thermally activate Chelex resin beads so they can directly bind single-stranded DNA
(B) To break high-molecular-weight DNA molecules into smaller target fragments suitable for PCR
(C) To rapidly evaporate aqueous extraction buffer, leaving behind highly concentrated DNA
(D) To lyse cell membranes and denature proteins, releasing DNA

87. A forensic scientist successfully extracts all the DNA from exactly 100 intact human diploid cells. Based on standard forensic biology constants,

Click Here to Buy book on Amazon

enzyme Reverse Transcriptase is utilized. This enzyme is originally derived from:
(A) Thermophilic bacteria
(B) Human epithelial cells
(C) Retroviruses
(D) Baker's yeast

73. In a batch of forensic DNA extractions, an "Extraction Blank" (or extraction negative control) is processed alongside the evidence samples. What does this blank contain?
(A) A precisely quantified standard reference sample of human nuclear DNA
(B) The untreated crime scene evidence specimen processed without extraction reagents
(C) An unexposed control swab gathered from a crime scene surface free of DNA
(D) Extraction reagents only, with no biological sample

74. Which of the following statements is TRUE regarding the electrokinetic injection process used in Capillary Electrophoresis (CE)?
(A) Applied voltage draws negatively charged DNA into the capillary
(B) DNA is injected mechanically using continuous high pressure supplied by a hydraulic syringe pump
(C) Sample injection efficiency remains completely independent of ambient ionic salt concentrations
(D) The total quantitative volume of PCR reaction product is driven entirely into the capillary column

75. Polyacrylamide gels (or polymers) are preferred over agarose for separating multiplex STR products in forensic science because:
(A) Polyacrylamide is completely non-toxic, non-hazardous, and significantly easier to cast than agarose
(B) Higher resolving power, separating fragments differing by single base pairs
(C) Polyacrylamide matrices reverse electrical polarity, causing migration toward negative electrodes
(D) Polyacrylamide conducts electric currents directly without requiring ionic buffer solutions

76. During Capillary Electrophoresis of STR amplicons, an Internal Lane Standard (ILS) is added to every sample. The primary purpose of the ILS is to:
(A) Measure total amplified DNA concentration within the sample mixture prior to detection
(B) Provides known fragment sizes to calibrate base pair sizing of sample alleles
(C) Act as a competitive chemical inhibitor that prevents overloading inside the capillary tube
(D) Function as an internal amplification control verifying success of the preceding PCR reaction

NODIA

77. In STR data analysis, what is the function of the Allelic Ladder?
(A) Contains common alleles for loci tested, enabling precise repeat number designation
(B) Establishes a quantitative fluorometric standard curve to determine total template DNA
(C) Flushes and rejuvenates the inner coating of the capillary tube between sample injections
(D) Serves as a visible tracking dye signaling completion of the electrophoretic separation run

78. A common artifact encountered when troubleshooting forensic STR electropherograms is "stutter". Stutter peaks are typically:
(A) Large false peaks located exactly 10 base pairs above true alleles due to incomplete denaturation
(B) Broad, irregular background baseline peaks generated by fluorescent dye blobs from degraded primers
(C) Minor peaks one repeat unit smaller than the true allele, from PCR strand slippage
(D) Artifact peaks appearing simultaneously across all fluorescent dye channels due to spectral pull-up

79. Massively Parallel Sequencing (MPS), also known as Next Generation Sequencing (NGS), is an emerging method in forensic DNA analysis. Which of the following is NOT a recognized advantage of MPS over traditional CE-based STR analysis?
(A) MPS can multiplex hundreds of markers (STRs, SNPs, mtDNA) in a single reaction
(B) MPS determines the exact nucleotide sequence of alleles, uncovering variation (isometric alleles) hidden in CE size-based separation
(C) MPS is highly effective in resolving complex DNA mixtures by identifying sequence variations

ANSWERS

1. (B) IV, II, V, I, III
Forensic DNA profiling follows a strict standard logical workflow to ensure sample integrity and reliable profiling results. The process begins with sample collection and screening, followed by DNA extraction to isolate cellular material. Next, DNA quantification determines the amount of recovered DNA, preceding Polymerase Chain Reaction amplification and final analysis via capillary electrophoresis.

2. (D) Processing evidence samples and reference samples in the same workspace simultaneously
Minimizing cross-contamination is critical in forensic DNA analysis. Evidence samples and reference samples must always be processed in separate physical spaces or at different times. Simultaneous processing of evidence and reference samples in the same workspace creates a high risk of cross-contamination, potentially compromising profile integrity, whereas using sterile consumables and unidirectional workflows prevents contamination.

3. (A) It increases the density of the organic phase to ensure distinct layer separation
In organic DNA extraction, phenol denatures cellular proteins, while chloroform is added to increase the overall density of the organic phase. This density difference facilitates a sharp, clear phase separation between the upper aqueous layer containing purified DNA and the lower organic layer containing proteins and cellular debris, thereby facilitating clean extraction recovery.

4. (C) By binding to polyvalent metal ions like magnesium, which are necessary cofactors for DNases
Chelex-100 is a styrene-divinylbenzene copolymer resin containing iminodiacetate ions that act as chelating agents. During the boiling step, cellular nucleases like DNases are released, which require divalent heavy metal cofactors such as magnesium to degrade DNA. Chelex sequesters these divalent ions, inactivating DNase enzymes and preventing thermal or enzymatic degradation of the DNA.

5. (A) Air-drying away from direct heat and sunlight, then packing in a porous paper bag
Biological evidence containing moisture must be thoroughly air-dried at room temperature away from direct heat and sunlight to prevent degradation. Storing wet biological evidence in airtight plastic containers promotes bacterial growth and fungal decay, destroying DNA. Packaging dried evidence in breathable paper containers allows air circulation, keeping the sample dry and stable during transportation and storage.

6. (C) Statement I is true but Statement II is false
Differential extraction separates female epithelial cells from male spermatozoa in sexual assault evidence. Sperm cell membranes contain extensive disulfide cross-links between proteins, making them resistant to mild lysis reagents like SDS and Proteinase K, which lyse epithelial cells first. Dithiothreitol is a reducing agent added in the second step, not the first step, to lyse spermatozoa.

7. (A) I and II only
Proteinase K digests proteins, including cellular nucleases and histones, thereby freeing genomic DNA and protecting it from enzymatic degradation. Sodium Dodecyl Sulfate is an ionic detergent that solubilizes cell membrane lipids and denatures proteins. Ethylene Diamine Tetraacetic Acid acts as a chelating agent that binds divalent cations required by nucleases, rather than directly rupturing nuclear envelopes.

8. (C) Presence of chaotropic salts and low pH
In magnetic bead and silica column extractions, DNA adsorption to silica surfaces occurs in the presence of high concentrations of chaotropic salts combined with an acidic or low pH environment. Chaotropic salts dehydrate nucleic acid molecules, disrupting the hydration shell around DNA and allowing silica surfaces to form ionic and hydrogen bonds with DNA phosphate backbones.

Downloaded from www.pdf.tube

what is the approximate expected total yield of nuclear DNA?
(A) 60 picograms
(B) 600 picograms
(C) 6 nanograms
(D) 60 nanograms

NODIA

88. Most commercial STR multiplex kits used in forensic science are optimized to require an input DNA target amount of approximately:
(A) 0.5 to 1.0 nanograms (ng)
(B) 50 to 100 nanograms (ng)
(C) 1 to 5 micrograms (μg)
(D) 5 to 10 picograms (pg)

89. Select the correct sequence of phases observed in a standard Real-Time quantitative PCR (qPCR) amplification plot.
(A) Linear Phase → Exponential Phase → Plateau Phase → Baseline Phase
(B) Baseline Phase → Exponential Phase → Linear Phase → Plateau Phase
(C) Plateau Phase → Linear Phase → Exponential Phase → Baseline Phase
(D) Baseline Phase → Plateau Phase → Linear Phase → Exponential Phase

90. In Capillary Electrophoresis analysis of STR markers, what term is used to describe an allele that contains a partial repeat sequence (e.g., TH01 allele 9.3, which has nine complete 4-bp repeats and one incomplete 3-bp repeat)?
(A) Microvariant
(B) Null allele
(C) Off-ladder allele
(D) Stutter product

short targets, whereas longer target sequences fail to amplify due to strand breaks, producing a low concentration ratio characteristic of degraded DNA.

18. (A) P-3, Q-2, R-1, S-4
Common PCR inhibitors originate from specific biological and environmental substrate sources. Heme is an iron-binding porphyrin component derived from red blood cells. Indigo dye is a chemical dye extracted from denim clothing fabrics. Humic acid originates from organic breakdown in soil and dirt. Melanin is a natural pigment polymer extracted from hair and skin tissues.

19. (A) Significantly increasing the amount of input DNA template
Increasing template volume to overcome inhibition also proportionally increases total inhibitor concentration in the reaction, further suppressing DNA polymerase activity. Proper strategies to relieve PCR inhibition include diluting the extract to lower inhibitor concentrations, adding Bovine Serum Albumin to sequester inhibitors, or performing additional clean-up steps using specialized silica filter columns to isolate DNA.

20. (C) Guanidinium thiocyanate
Solid-phase silica extraction relies on chaotropic agents like guanidinium thiocyanate or guanidinium hydrochloride. These chaotropic salts disrupt the hydrogen bonding structure of water molecules, denaturing surrounding proteins and nucleases while stripping the hydration shell from nucleic acid molecules. This chemical environment facilitates the reversible binding of naked DNA backbones onto silica membranes or magnetic beads.

21. (A) Kary Mullis
The Polymerase Chain Reaction was conceived and invented by American biochemist Kary Mullis in 1983 while working at Cetus Corporation. This revolutionary technique allowed exponential enzymatic amplification of specific DNA sequences in vitro. For this groundbreaking invention, Mullis was awarded the Nobel Prize in Chemistry in 1993, transforming molecular biology, genetics, and forensic science forever.

22. (D) Geothermal hot springs located in Yellowstone National Park
Taq DNA polymerase is a thermostable enzyme originally isolated from the thermophilic bacterium Thermus aquaticus. Thomas D. Brock discovered this organism in high-temperature geothermal hot springs within Yellowstone National Park. Because the enzyme evolved to survive extreme heat, Taq polymerase remains active despite repeated high-temperature denaturation steps during thermal cycling, making automated PCR possible.

23. (B) They serve as a cofactor for the Taq DNA polymerase enzyme
Divalent magnesium ions provided by magnesium chloride serve as essential cofactors for Taq DNA polymerase. Magnesium ions bind to the active site of the polymerase enzyme, facilitating the chemical transfer of phosphate groups during phosphodiester bond formation. Additionally, magnesium stabilizes the negative charges on phosphate backbones during hybridization between primer strands and target DNA templates.

24. (C) They serve as building blocks incorporated into the newly synthesized DNA strand
Deoxynucleotide triphosphates—dATP, dCTP, dGTP, and dTTP—act as essential monomeric substrate building blocks during PCR. Taq DNA polymerase incorporates these free nucleotides onto the 3'-hydroxyl end of extending primers, forming complementary strands. Hydrolysis of high-energy phosphate bonds in dNTPs provides the necessary chemical energy to drive phosphodiester bond synthesis along growing nucleic acid chains.

25. (C) I and III only
Proper primer design requires a balanced GC content of 40 to 60 percent to ensure structural stability and reliable hybridization. Matching melting temperatures between forward and reverse primers ensures simultaneous annealing during thermal cycling cycles. However, complementary sequences at the 3' ends must be strictly avoided because they cause primer-dimer hybridization, making statement II false.

26. (A) 95°C, 60°C, 72°C
A standard PCR thermal cycle consists of three sequential steps with specific temperature regimes. Denaturation occurs at elevated

Click Here to Buy book on Flipkart

layers upon centrifugation. The organic mixture, containing dense chloroform and phenol, settles at the bottom with a density greater than water. The polar, aqueous phase stays at the top because it has lower density. Polar nucleic acids dissolve preferentially in this upper aqueous phase, enabling easy pipetting.

45. (A) Chelex chelates essential magnesium ions, inhibiting PCR
Chelex-100 resin carries negatively charged iminodiacetate chelating groups designed to bind polyvalent metal ions. If resin beads are accidentally carried over into a PCR reaction mixture, the Chelex will sequester the free divalent magnesium ions (Mg^{2+}) present in the buffer. Because Mg^{2+} is an obligatory cofactor for Taq DNA polymerase, its depletion results in total PCR inhibition.

46. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
In solid-phase silica extraction, ethanol is a critical component of wash buffers. High concentrations of ethanol reduce dielectric constant conditions, keeping DNA molecules insoluble, dehydrated, and securely bound to the silica matrix. Simultaneously, the wash solution dissolves and flushes away co-extracted contaminants, cellular proteins, and residual chaotropic salts without prematurely eluting the target DNA from the column.

47. (D) Washed with purification reagent and buffer to remove inhibitors while keeping DNA bound
Direct PCR from FTA paper relies on washing small paper punches with specialized purification reagents and low-salt buffers prior to thermal cycling. These washing steps wash away heme, proteins, cell debris, and potential PCR inhibitors present in biological fluids. The purified cellular DNA remains tightly bound to the matrix paper, allowing direct addition of PCR master mix into the tube.

48. (C) It breaks disulfide bonds in sperm membranes during the second lysis step
Sperm nuclear chromatin and head membranes are heavily reinforced with protamines stabilized by extensive cysteine disulfide bonds. In differential extraction, female epithelial cells are lysed first without DTT. In the second step, Dithiothreitol is added as a strong reducing agent to break these covalent disulfide bonds, allowing Proteinase K and detergents to lyse spermatozoa and release male DNA.

49. (B) EDTA
Skeletal remains store inorganic mineralized calcium hydroxyapatite within bone matrices. During extraction, co-dissolved free calcium ions (Ca^{2+}) act as potent enzymatic inhibitors of Taq DNA polymerase during downstream PCR. Ethylene Diamine Tetraacetic Acid is a hexadentate chelating agent that binds calcium ions, forming stable soluble complexes that demineralize bone powder and prevent calcium-mediated PCR inhibition.

50. (A) I and II only
Naturally shed hair shafts consist of cornified keratin lacking intact nucleated cells, making them unsuitable for standard nuclear STR profiling. However, hair shafts contain abundant circular mitochondrial DNA suitable for sequencing. Active growing anagen roots contain abundant nuclear DNA, whereas resting telogen roots yield significantly less, rendering statement III incorrect because anagen roots yield higher DNA.

51. (B) 100 picograms (pg) of template DNA
Low Template DNA profiling refers to analyzing micro-gram quantities of genomic material, typically defined operational thresholds under 100 picograms of input DNA. Because one human diploid cell contains approximately 6.6 picograms of DNA, low template samples contain fewer than 15 cell equivalents. Analyzing low template DNA requires specialized PCR protocols due to stochastic phenomena like allele drop-out.

52. (C) Quantification determines the exact sequence of alleles present at every locus
DNA quantification measures total human-specific DNA concentration in an extract to normalize input template amounts for PCR. Standardizing input DNA between 0.5 and 1.0 nanograms prevents stochastic effects from low template input and signal saturation artifacts from excessive template input. Quantification does not evaluate target allele sequences or repeat counts, which require subsequent capillary electrophoresis.

NODIA

DNA fragments migrate under an electric field, smaller fragments maneuver through the polymer network faster than larger fragments, achieving precise size resolution.

36. (C) DNA molecules possess a net negative charge due to the phosphate backbone
Nucleic acid molecules possess a uniform, constant negative charge-to-mass ratio due to the ionized phosphate groups along their sugar-phosphate backbones at physiological pH. When an electrical potential is applied across an agarose gel matrix during electrophoresis, these negatively charged DNA molecules migrate away from the negative cathode and toward the positively charged electrode or anode.

37. (A) By laser excitation of fluorescent dyes on primers, detecting emitted light via CCD
Automated genetic analyzers detect amplified STR products using multi-color fluorescence. Forward primers are covalently tagged with distinct fluorescent dyes. As labeled DNA fragments pass through the capillary detection window, an argon-ion or solid-state laser excites the dyes. Emitted fluorescent light is dispersed by a diffraction grating and captured by a charge-coupled device camera for precise signal identification.

38. (D) Primer-dimer formation
Primer-dimer formation occurs when forward and reverse primers hybridize to one another due to 3'-terminal sequence complementarity. During PCR cycling, DNA polymerase extends these hybridized primer pairs, producing short double-stranded artifacts typically under 50 base pairs long. Excessive primer-dimer formation consumes available primers and Taq polymerase, leading to a prominent fast-migrating low-molecular-weight band and weak target amplification.

39. (A) I, II, and IV
Rapid DNA technology integrates sample extraction, amplification, separation, and STR profiling into a single automated microfluidic cartridge system, delivering complete profiles within two hours. Designed for decentralized deployment in law enforcement stations, it accelerates suspect identification. However, statement III is incorrect because the microfluidic cartridges rely completely on standard chemical reagents, enzymatic reaction buffers, and fluorescent PCR primers.

40. (A) P-2, Q-4, R-3, S-1
Forensic extraction methods utilize distinct biochemical mechanisms. Organic extraction uses phenol and chloroform for liquid phase separation of proteins and nucleic acids. Chelex extraction employs an ion-exchange resin combined with a boiling step to isolate single-stranded DNA. Silica-based extraction uses chaotropic salts to adsorb DNA onto silica membranes. Differential extraction uses dithiothreitol to lyse sperm cells selectively.

NODIA

41. (D) Swabbing the oral buccal mucosa
Swabbing the oral buccal mucosa inside the cheek is the standard, least invasive method for collecting reference DNA samples from living individuals. Buccal swabs yield high concentrations of nucleated epithelial cells without requiring invasive medical procedures like venipuncture, tooth extraction, or hair plucking. Samples collected on buccal swabs are easily preserved and yield clean high-molecular-weight nuclear DNA.

42. (A) Sealing a wet, blood-soaked shirt in a plastic bag to prevent fluid leakage
Sealing wet or moisture-laden biological evidence inside impermeable plastic bags creates an enclosed humid environment that promotes rapid microbial growth and enzymatic decay, leading to severe DNA degradation. Biological evidence must always be thoroughly air-dried prior to packaging in porous, breathable paper containers to ensure sample preservation, maintaining proper chain of custody protocols throughout forensic processing.

43. (B) Cross-linking contaminating DNA via thymine dimers to prevent amplification
Ultraviolet radiation at 254 nanometers induces the formation of covalent pyrimidine dimer cross-links, predominantly thymine dimers, within nucleic acid backbones. These structural lesions distort double-stranded DNA helix geometry and physically block Taq DNA polymerase movement along template strands during PCR. Decontaminating safety cabinets with UV light inactivates stray background nucleic acids, preventing non-specific foreign amplification in subsequent assays.

44. (B) The top layer
During organic phenol-chloroform extraction, phase separation forms two immiscible liquid

temperatures near 95°C to break hydrogen bonds between double-stranded template strands. Primer annealing occurs at lowered temperatures around 55°C to 60°C, allowing oligonucleotides to bind to complementary targets. Elongation occurs at 72°C, the optimal temperature for Taq polymerase.

27. (B) Heating the reaction to 94–95°C to separate the double-stranded DNA template
The denaturation step in PCR involves heating the reaction mixture to elevated temperatures between 94°C and 95°C. Heat energy disrupts the weak hydrogen bonds holding complementary base pairs together in double-stranded DNA, separating the template into two single strands. This exposes single-stranded nucleotide sequences, making them accessible for primer annealing in subsequent cycling phases.

28. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Thermal stringency during annealing controls primer specificity. Setting an annealing temperature below the optimal melting threshold reduces stringency, permitting oligonucleotide primers to hybridize stable mismatched double strands at non-target sites. This non-specific binding allows DNA polymerase to synthesize non-target secondary amplicons, causing unwanted extra bands or spurious background peaks on electropherograms.

29. (C) 72°C
The extension phase of a standard PCR cycle is performed at approximately 72°C. This temperature represents the optimum enzymatic activity range for Taq DNA polymerase, enabling rapid extension of new DNA strands at a rate exceeding 1,000 nucleotides per minute. At lower temperatures, synthesis rates decline, while higher temperatures induce enzyme instability or strand denaturation.

30. (C) Approximately 1 billion
Under 100 percent theoretical efficiency, the number of target DNA copies doubles with each PCR cycle according to the mathematical formula 2^n, where n represents the total cycle count. After 30 cycles, one double-stranded template produces 2^{30} copies, which equals approximately $1,073,741,824$ target amplicons, representing approximately one billion double-stranded target DNA molecules.

31. (D) Peltier thermoelectric cooling blocks
Modern thermal cyclers utilize Peltier thermoelectric heating and cooling blocks to achieve rapid, precise temperature transitions. A Peltier device works by passing an electric current through solid-state semiconductor junctions, causing one side to absorb heat while the other releases it. Reversing current direction rapidly alternates heating and cooling, providing precise thermal cycling control across PCR phases.

32. (C) Simultaneous amplification of multiple DNA loci in one tube using distinct primer sets
Multiplex PCR is an advanced molecular technique where multiple target genetic loci are amplified simultaneously in a single reaction vessel. This is achieved by adding multiple unique primer pairs targeting different genomic regions into the master mix. Multiplexing conserves precious limited biological evidence samples and significantly increases laboratory throughput in forensic STR profiling workflows.

33. (B) Messenger RNA (mRNA)
Reverse Transcription PCR utilizes messenger RNA molecules as starting template material for fluid identification. Tissue-specific gene expression produces unique mRNA transcripts characteristic of specific body fluids like blood, semen, or saliva. The enzyme Reverse Transcriptase synthesizes complementary DNA from the target mRNA template, which is subsequently amplified by standard PCR methods to confirm fluid identity.

34. (A) Both Statement I and Statement II are true
Controls are mandatory quality assurance measures in forensic amplification. Positive controls utilize known standard human DNA templates, such as cell line 9947A, to confirm overall reagent performance and thermocycling efficiency. Negative controls contain all reaction reagents minus template DNA, serving as sensitive indicators to detect accidental contamination or foreign DNA present within master mix components.

35. (A) A liquid polymer solution (e.g., POP-4)
Modern capillary electrophoresis instruments use uncrosslinked liquid polymer solutions, such as Performance Optimized Polymer 4, as the dynamic separation medium inside glass capillaries. The polymer chains entangle to create a sieve matrix. As negatively charged

Downloaded from www.pdf.tube

53. (A) Falsely elevate DNA concentration because RNA absorbs UV at 260 nm
UV spectrophotometry measures total light absorbance at 260 nanometers without distinguishing between nucleic acid structures. Both single-stranded and double-stranded RNA absorb UV light strongly at 260 nm due to purine and pyrimidine base ring structures. Consequently, co-extracted RNA molecules elevate total 260 nm absorbance, leading to a false overestimation of total DNA concentration in the measured sample.

54. (D) Taq polymerase cleaves the probe, separating fluorophore from quencher
TaqMan quantitative assays utilize dual-labeled fluorogenic hybridization probes containing a reporter dye and a quencher molecule. When intact, spatial proximity allows energy transfer from reporter to quencher, suppressing fluorescence. During extension, the 5' to 3' exonuclease activity of Taq DNA polymerase cleaves the hybridized probe, physically separating reporter from quencher and generating a proportional fluorescent signal.

55. (B) To determine if PCR inhibitors are present in the sample extract
An Internal Positive Control consists of a synthetic non-human DNA template and corresponding primers co-amplified in real-time qPCR assays. Because the IPC template concentration is constant, any shift or delay in its cycle threshold (C_T) value reveals the presence of co-extracted enzymatic PCR inhibitors within test samples, enabling analysts to implement purification strategies.

56. (C) Inactivating Taq DNA polymerase directly
Heme is an iron-containing porphyrin compound abundant in red blood cells. In PCR reactions, hemolyzed heme molecules bind directly to the active site of Taq DNA polymerase, causing conformational changes that destroy enzymatic activity. Although heme can also bind to magnesium, its primary mechanism of PCR inhibition is direct, irreversible inactivation of the thermostable polymerase enzyme itself.

57. (D) Binds PCR inhibitors like hematin or humic acid
Bovine Serum Albumin is a carrier protein added to PCR master mixes to mitigate enzymatic inhibition. BSA contains hydrophobic domains that bind co-extracted inhibitory compounds, such as hematin from blood or humic acids from soil. By sequestering these inhibitors, BSA prevents them from binding to and inactivating Taq DNA polymerase, maintaining high PCR amplification efficiency.

58. (A) 2, 4, 1, 5, 3
Thermal cycling follows a strict chronological order. The protocol starts with initial denaturation (2) to completely melt double-stranded genomic DNA. Each regular cycle then begins with denaturation (4) of template strands, followed by primer annealing (1) to target sequences, and primer extension (5) by DNA polymerase. Finally, a single final extension (3) step completes the entire program.

59. (B) I, III, and IV
In vitro PCR amplification requires four fundamental chemical components: template DNA containing target sequences, oligonucleotide primers defining target boundaries, deoxynucleotide triphosphates providing building blocks, and thermostable DNA polymerase. DNA ligase is an enzyme that repairs nicked sugar-phosphate backbones during in vivo replication and is completely unnecessary for in vitro PCR amplification processes.

60. (A) P-2, Q-3, R-4, S-1
PCR components and concepts have specific functional roles. Forward and reverse primers flank target genomic regions to initiate synthesis. Amplicons represent specific amplified target DNA products generated during PCR. Taq polymerase is the thermostable enzyme responsible for synthesizing new DNA strands. Thermocycling describes the process of rapidly alternating temperatures required to drive denaturation, annealing, and extension phases.

61. (A) Pfu polymerase - Produces 'A-tailed' products for STR cloning
Pfu polymerase possesses proofreading $3'$ to $5'$ exonuclease activity that removes misincorporated nucleotides, resulting in blunt-ended PCR products. In contrast, Taq DNA polymerase lacks $3'$ to $5'$ proofreading exonuclease activity and naturally adds a non-template adenine (A) nucleotide to the $3'$ end of amplicons. Therefore, pairing Pfu polymerase with A-tailed product synthesis is incorrect.

NODIA

(C) It should be easily and imperceptibly administrable in food or drink
(D) It should have a strong, repulsive taste and distinct color

19. All of the following substances act as organic irritant poisons of animal origin EXCEPT:
(A) Croton oil
(B) Cantharides
(C) Snake venom
(D) Scorpion venom

20. Consider the following statements regarding the classification of poisons:
I. Glass powder and diamond dust act as mechanical irritants.
II. Phosphorus is classified as a non-metallic inorganic irritant.
III. Barbiturates are classified as somniferous neurotoxic poisons.
IV. Dhatura is a spinal neurotoxic poison.
Which of the above statements are correct?
(A) I, II, and III only
(B) II, III, and IV only
(C) I, III, and IV only
(D) I, II, III, and IV

21. Transverse white bands on the fingernails, commonly associated with chronic arsenic poisoning, are medically known as:
(A) Aldrich-Mees lines
(B) Burtonian lines
(C) Tardieu spots
(D) Koplik spots

22. Minamata disease, characterized by severe neurological symptoms including ataxia and sensory loss, is caused by chronic exposure to which heavy metal?
(A) Lead
(B) Cadmium
(C) Thallium
(D) Methylmercury

23. A characteristic blue-black line along the gingival margin of the gums is a classic diagnostic sign of chronic poisoning by:
(A) Copper
(B) Lead
(C) Arsenic
(D) Iron

24. Acute poisoning by which of the following metal salts typically produces vomitus that is blue or green in colour?
(A) Lead acetate
(B) Arsenic trioxide
(C) Copper sulphate
(D) Mercuric chloride

25. Severe alopecia (hair loss) paired with painful peripheral neuropathy is the hallmark symptom of poisoning by which element?
(A) Cyanide
(B) Antimony
(C) Phosphorus
(D) Thallium

26. During a medico-legal autopsy, the forensic pathologist detects a distinct odour of bitter almonds emanating from the stomach contents. This strongly suggests poisoning by:
(A) Cyanide
(B) Organophosphates
(C) Aluminium phosphide
(D) Carbolic acid

27. Carbon monoxide poisoning results in characteristic post-mortem lividity (hypostasis) that appears:
(A) Dark blue
(B) Cherry red
(C) Chocolate brown
(D) Pale yellow

28. The primary mechanism of toxicity in carbon monoxide poisoning is due to the gas's high affinity for:
(A) Cytochrome c oxidase enzyme complex in functional mitochondria
(B) Haemoglobin, forming carboxyhaemoglobin
(C) Acetylcholinesterase enzymes present at central nerve synapses
(D) Protective myelin sheaths surrounding peripheral sensory nerves

29. Cyanide exerts its rapid lethal effect at the cellular level by directly inhibiting which critical enzyme?
(A) Cytochrome c oxidase
(B) Monoamine oxidase
(C) Acetylcholinesterase
(D) Carbonic anhydrase

30. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Carbon monoxide is considered an extremely dangerous asphyxiant gas even at relatively low ambient concentrations.

Click Here to Buy book on Amazon

temperatures lower, primers and dual-labeled fluorogenic probes bind target strands. During extension, Taq DNA polymerase moves along template strands and uses its 5' to 3' exonuclease activity to cleave bound probes, releasing reporter fluorophores from quenchers to generate fluorescence.

72. (C) Retroviruses
Reverse transcriptase is an RNA-dependent DNA polymerase enzyme naturally produced by retroviruses, such as Moloney Murine Leukemia Virus or Avian Myeloblastosis Virus. Retroviruses use this enzyme to transcribe single-stranded viral RNA genomes into double-stranded DNA before integrating into host host cell genomes. Forensic assays adapt retroviral reverse transcriptase to synthesize cDNA from sample mRNA.

73. (D) Extraction reagents only, with no biological sample
An extraction blank serves as a vital negative control during nucleic acid extractions. It consists exclusively of extraction reagents processed without adding biological sample material. By subjecting the blank to identical extraction, amplification, and electrophoresis workflows as real evidence, analysts detect potential background contamination arising from reagents, equipment, or handling techniques.

74. (A) Applied voltage draws negatively charged DNA into the capillary
Electrokinetic injection introduces fluorescently labeled DNA into capillaries by applying a temporary voltage across the sample vial and capillary tip. Because DNA molecules carry net negative charges on their phosphate backbones, the positive voltage draws DNA into the capillary inlet. Injection efficiency depends heavily on sample ionic strength, requiring deionized formamide to minimize salt interference.

75. (B) Higher resolving power, separating fragments differing by single base pairs
Polyacrylamide matrices offer significantly higher physical resolution than agarose gels due to smaller, more uniform pore size distributions. This fine pore structure allows single-base-pair resolution required for STR locus analysis, such as distinguishing microvariant alleles like TH01 9.3 from allele 10. Agarose gels lack the resolving power necessary to separate single-nucleotide length differences.

76. (B) Provides known fragment sizes to calibrate base pair sizing of sample alleles
An Internal Lane Standard contains labeled DNA fragments of precisely known base pair sizes, dyed with a distinct fluorescent color. Added to every sample prior to capillary electrophoresis, the ILS migrates alongside target amplicons. Analysis software uses ILS peaks to generate a sizing calibration curve, converting migration time into accurate fragment sizes for allele calling.

77. (A) Contains common alleles for loci tested, enabling precise repeat number designation
An Allelic Ladder is a reference mixture containing major known alleles for tested STR loci. Ran within capillary electrophoresis batches, the ladder accounts for environmental temperature variations and migration shifts. Analysis software compares sample fragment sizes against allelic ladder sizes within identical dye channels to convert base pair measurements into standardized repeat unit designations.

78. (C) Minor peaks one repeat unit smaller than the true allele, from PCR strand slippage
Stutter is a common PCR artifact observed during short tandem repeat amplification. It produces minor product peaks that are typically one repeat unit shorter than true allele peaks. Stutter occurs when Taq DNA polymerase slips during synthesis, causing temporary strand misalignment. Because stutter height is predictable, software filters distinguish true allele peaks from stutter artifacts.

NODIA

79. (D) MPS instruments are generally cheaper, faster, and require less complex bioinformatics software than CE
Massively Parallel Sequencing offers advantages such as high marker capacity, single-nucleotide sequence resolution for isometric alleles, and improved mixture deconvolutions. However, MPS platforms are significantly more expensive to acquire and maintain, require longer run times, and depend on complex bioinformatics infrastructure compared to traditional capillary electrophoresis systems, rendering statement D inaccurate.

62. (B) 18 to 30 base pairs
Oligonucleotide primers engineered for forensic multiplex PCR are typically between 18 and 30 base pairs in length. This specific length range provides sufficient sequence specificity to ensure primers bind uniquely to intended target loci within complex human genomic DNA, while maintaining practical hybridization dynamics and melting temperatures suitable for routine thermocycling protocols.

63. (C) pH 8.0 - 8.5
Tris-HCl is a zwitterionic organic buffer agent added to PCR master mixes to stabilize hydrogen ion concentration. Taq DNA polymerase requires a slightly alkaline environment for optimal enzymatic activity, with maximum synthesis performance occurring between pH 8.0 and pH 8.5 at room temperature, which adjusts slightly during high-temperature thermal cycling.

64. (C) Taq polymerase activity drops significantly, yielding little or no product
Divalent magnesium ions serve as indispensable cofactors for Taq DNA polymerase enzymatic activity. Sub-optimal or low magnesium chloride concentrations dramatically reduce catalytic polymerase activity, leading to poor extension rates or complete failure of PCR amplification. Conversely, excessive magnesium concentrations stabilize non-specific primer binding and reduce hybridization stringency, promoting unwanted mispriming and primer-dimer formation.

65. (B) 30 to 60 seconds
During routine thermal cycling of human genomic DNA, the denaturation step at 94°C to 95°C is held for 30 to 60 seconds per cycle. This duration provides adequate thermal energy to completely melt double-stranded target templates without exposing Taq DNA polymerase or template backbones to excessive thermal degradation over multiple cycles.

66. (D) 3°C to 5°C below the lowest Tm of the primers
The annealing temperature in PCR protocols is typically selected to be 3°C to 5°C below the lowest melting temperature (T_m) among designed primer pairs. Operating slightly below the primer melting temperature promotes stable hydrogen bonding between primers and complementary target sequences while maintaining sufficient thermal stringency to inhibit non-specific binding at off-target sites.

67. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Standard forensic STR amplification protocols end with a final extension step held at 60°C to 72°C for 5 to 15 minutes. This step ensures Taq DNA polymerase completes extension of truncated strands and adds an extra non-template dATP onto the 3' end of amplicons, converting split peaks into uniform adenylated products for precise capillary electrophoresis.

68. (C) 80
Under theoretically ideal 100 percent efficient amplification conditions, target genomic DNA copy numbers double exponentially during each complete thermal cycle according to the exponential amplification equation $N_n = N_0 \times 2^n$. Starting with an initial template concentration (N_0) of exactly 10 target molecules, completing $n = 3$ thermal cycles successfully yields $10 \times 2^3 = 10 \times 8 = 80$ double-stranded target DNA copies.

69. (A) Heat absorption or release at the junction of two conductors when electric current flows
The Peltier effect describes heat absorption or release occurring at the boundary junction of two dissimilar electrical conductors when direct electric current flows through the circuit. In modern thermal cyclers, solid-state Peltier elements capitalize on this physical phenomenon. Reversing electric current direction rapidly switches thermoelectric blocks between heating and cooling states, permitting rapid ramp rates.

70. (A) I and II only
Multiplex PCR development requires careful primer design to prevent primer-dimer formation and fine-tuning primer concentrations for balanced peak heights across loci. However, amplicons labeled with the same dye must be designed in non-overlapping size ranges to prevent resolution overlap during capillary electrophoresis, making statement III incorrect because size ranges must strictly avoid overlapping.

71. (A) Denaturation → Probe binding → Polymerase extension → Probe cleavage → Fluorescence
TaqMan real-time PCR proceeds through a precise biochemical sequence. Elevated temperatures induce template denaturation. As

Downloaded from www.pdf.tube

89. (B) Baseline Phase → Exponential Phase → Linear Phase → Plateau Phase
Real-Time quantitative PCR amplification plots follow four distinct chronological phases. The reaction begins in the baseline phase where fluorescence remains below background thresholds. Next, doubling yields the exponential phase, where quantitative threshold values are calculated. As reagents become limiting, amplification enters the linear phase, eventually ending in the plateau phase where reaction components are exhausted.

90. (A) Microvariant
In short tandem repeat marker analysis, a microvariant is defined as an allele containing an incomplete repeat unit alongside complete repeats. For example, the TH01 locus allele 9.3 consists of nine complete four-base-pair repeats plus one incomplete three-base-pair sequence. Microvariants migrate predictably during capillary electrophoresis and are identified by comparing fragment size against allelic ladders.

NODIA

www.nodia.in

80. (A) P-2, Q-1, R-4, S-3
Forensic equipment performs targeted analytical procedures. Microcentrifuges apply centrifugal force to separate cellular debris from liquid extract solutions. Thermal cyclers precisely adjust temperatures to amplify target DNA loci via PCR. Spectrophotometers measure UV light absorbance to quantify DNA purity and concentration. Genetic analyzers perform size separation and detection of fluorescently labeled amplicons.

81. (B) Documentation tracking the seizure, custody, transfer, and disposition of evidence
Chain of custody represents the chronological, unbroken documentation tracking the collection, transfer, analysis, storage, and legal disposition of forensic evidence. Maintaining detailed logs specifying handler identities, dates, and handling purposes ensures legal defensibility and evidence integrity, demonstrating to courts that physical samples remained unaltered and secure throughout investigation and laboratory analysis.

82. (D) Stored in paper envelopes with desiccant at room temp or 4°C
FTA cards contain chemical matrix coatings that lyse cells and immobilize DNA. To ensure long-term DNA stability, cards should be stored inside breathable paper envelopes or sealed containers with silica desiccant packs at room temperature or refrigerated at 4°C. Keeping samples dry prevents hydrolytic cleavage, while avoiding liquid immersion maintains matrix chemical preservation.

83. (D) Statement I is false but Statement II is true
DNA laboratory design requires strict unidirectional workflows moving from pre-PCR areas, where low-copy evidence is handled, forward to post-PCR areas, where amplified products are analyzed. Reversing workflow back toward pre-PCR spaces introduces amplified DNA aerosol contamination into evidence extraction areas. Dedicated pipettes and equipment must be physically segregated within distinct workspaces, validating statement II.

84. (C) 56°C
Proteinase K is a broad-spectrum serine protease derived from the fungus Engyodontium album. During cell lysis steps in DNA extraction, Proteinase K exhibits maximum enzymatic digestion activity at 56°C. Operating at 56°C rapidly digests cellular proteins, histones, and nucleases without denaturing genomic DNA or completely inactivating the protease enzyme itself.

85. (A) To precipitate DNA from aqueous solution
Adding cold absolute ethanol or isopropanol to an aqueous DNA solution reduces the dielectric constant of the liquid environment. In the presence of monovalent sodium or ammonium cations, the alcohol strips hydration shells surrounding nucleic acids, allowing negatively charged phosphate backbones to form ionic bonds with cations and precipitate out of solution as visible nucleic acid filaments.

86. (D) To lyse cell membranes and denature proteins, releasing DNA
In Chelex-100 extraction, incubating samples at 100°C for 8 minutes provides thermal energy to break open cell membranes and lyse nuclear envelopes. Heat denatures cellular proteins, including nucleases, releasing single-stranded genomic DNA into solution. Chelex resin simultaneously sequesters heavy metal ions released during lysis, protecting single-stranded DNA from enzymatic degradation at elevated temperatures.

87. (B) 600 picograms
A single human diploid cell contains approximately 6.6 picograms (or roughly 6 picograms) of nuclear genomic DNA across its 46 chromosomes. Calculating the total theoretical DNA yield from 100 intact diploid human cells involves multiplying $100 \times 6.6\text{ pg}$, yielding approximately 660 picograms, which closely matches the expected standard benchmark value of 600 picograms.

88. (A) 0.5 to 1.0 nanograms (ng)
Commercial forensic Short Tandem Repeat multiplex kits are optimized to perform reproducibly with an optimal target input of 0.5 to 1.0 nanograms of human genomic DNA. This input level provides balanced locus amplification, minimizing stochastic artifacts like allele drop-out caused by low template DNA, while avoiding peak saturation, pull-up, and off-scale signals caused by template overload.

Click Here to Buy book on Flipkart

(D) Peripheral and autonomic cardiac poisons

9. Which of the following plant-derived substances is a classic example of a cardiac poison?
(A) Cannabis sativa
(B) Dhatura fastuosa
(C) Papaver somniferum
(D) Nerium oleander

10. Carbon monoxide and hydrogen cyanide cause toxicity primarily by interfering with respiration and tissue oxygenation. Under which classification do they fall?
(A) Asphyxiants
(B) Mechanical irritants
(C) Corrosives
(D) Deliriant neurotoxins

11. When classifying poisons by their mode of action, poisons that produce massive local tissue destruction at the site of application without necessarily entering systemic circulation are termed:
(A) Systemic poisons
(B) Corrosive poisons
(C) Metabolic poisons
(D) Neurotoxic poisons

12. Match List I with List II.
List I: (Poison Classification)
P. Corrosive poison
Q. Inorganic irritant
R. Spinal neurotoxin
S. Cardiac poison
List II: (Example)
1. Strychnine
2. Nitric acid
3. Aconite
4. Arsenic
Select the correct option from the codes given below:
(A) P-2, Q-4, R-1, S-3
(B) P-4, Q-2, R-3, S-1
(C) P-2, Q-1, R-4, S-3
(D) P-3, Q-4, R-1, S-2

13. Consider the following statements regarding factors that can modify the physiological action of a poison in a human body:
I. Age and underlying health condition of the victim
II. Route of administration
III. Time of the day the poison was manufactured
Which of the above statements is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

14. Which route of poison administration generally results in the most rapid onset of toxic symptoms, assuming the dose is identical?
(A) Oral ingestion
(B) Dermal absorption
(C) Intravenous injection
(D) Intramuscular injection

15. The pharmacokinetic phase of a toxic substance involves several sequential physiological processes. Consider the following processes:
I. Distribution
II. Absorption
III. Excretion
IV. Metabolism
Which of the following represents the correct chronological order of these processes from ingestion to elimination?
(A) II, I, IV, III
(B) I, II, III, IV
(C) II, IV, I, III
(D) I, IV, II, III

16. In toxicological evaluation, the term "LD50" refers to:
(A) The exact dose required to cause death in humans within 50 minutes of exposure
(B) The maximum legal concentration allowed in 50 millilitres of whole blood
(C) The dose lethal to 50% of a test animal population
(D) The physiological concentration that degrades by 50% in human liver tissue

17. A poisoning case characterized by a single large exposure resulting in sudden, severe symptoms and rapid onset of toxicity is medically termed:
(A) Chronic poisoning
(B) Acute poisoning
(C) Sub-acute poisoning
(D) Idiopathic poisoning

18. Which of the following characteristics is NOT typically associated with an ideal homicidal poison?
(A) It should be highly toxic and lethal even in extremely small doses
(B) It should reliably produce symptoms resembling a common natural disease

Downloaded from www.pdf.tube

CHAPTER 17

Poison Classification and Toxicological Analysis

1. Mathieu Orfila is widely recognized as the father of modern forensic toxicology. Which of the following major contributions is directly attributed to him?
(A) Development of the Marsh test for arsenic
(B) First systematic classification of poisons based on physiological action and tissue damage
(C) Discovery of the biological antidote for carbon monoxide poisoning
(D) Invention of gas chromatography for volatile poison isolation

2. In medico-legal terminology, a poison is most accurately defined as:
(A) Any substance that inevitably causes death when administered intravenously
(B) A synthetic chemical substance capable of altering genetic structures permanently
(C) A corrosive liquid that destroys tissues exclusively on direct physical contact
(D) Any substance which, when introduced into or absorbed by a living organism, causes severe illness or death due to its chemical action

3. Which of the following statements best describes the primary scope of forensic toxicology within a Forensic Science Laboratory?
(A) Analysing biological exhibits to establish the presence and quantity of poisons for legal adjudication
(B) Developing new therapeutic antidotes for agricultural chemical exposure
(C) Treating living patients who have been severely exposed to pesticide poisoning
(D) Monitoring environmental air quality for industrial toxic pollutants in urban areas

4. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Forensic toxicologists must routinely search for metabolic byproducts of a poison in viscera rather than just the parent compound.
Reason (R): Many organic poisons undergo rapid biotransformation and degradation in the human liver before exerting their lethal effects.
Select the correct answer from the options given below:
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

NODIA

5. The branch of toxicology that specifically deals with the medical treatment, diagnosis, and management of poisoned patients in a hospital setting is known as:
(A) Clinical Toxicology
(B) Environmental Toxicology
(C) Forensic Toxicology
(D) Analytical Toxicology

6. Strong alkalis such as sodium hydroxide and strong acids such as sulphuric acid are classified under which major category of poisons?
(A) Neurotoxic poisons
(B) Cardiac poisons
(C) Asphyxiants
(D) Corrosive poisons

7. Which of the following is an example of an inorganic irritant poison?
(A) Strychnine
(B) Arsenic
(C) Ricin
(D) Snake venom

8. Poisons that act primarily on the central nervous system, such as opium and strychnine, are broadly classified as:
(A) Corrosive and tissue-destroying poisons
(B) Mechanical and physical irritant poisons
(C) Somniferous and spinal neurotoxins

Reason (R): Carbon monoxide binds to haemoglobin with an affinity approximately 200 to 250 times greater than that of oxygen.
Select the correct answer from the options given below:
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

31. Which haematological finding is considered a classic indicator of chronic lead poisoning (Plumbism)?
(A) Sickling of mature circulating red blood cells
(B) Severe and extreme persistent leukopenia
(C) Hyperchromic macrocytic megaloblastic anaemia
(D) Basophilic stippling of erythrocytes

32. British Anti-Lewisite (BAL), medically known as Dimercaprol, is widely used as an effective chemical antidote for poisoning by:
(A) Synthetic organophosphate compounds
(B) Inhaled carbon monoxide gas
(C) Arsenic and mercury
(D) Ingested cyanide salts

33. Which heavy metal exerts its toxic effect partly by substituting for potassium in the body due to their similar ionic radii, thereby disrupting cellular functions?
(A) Lead
(B) Thallium
(C) Mercury
(D) Antimony

34. Match List I with List II.
List I: (Metallic Poison)
P. Arsenic
Q. Lead
R. Mercury
S. Copper
List II: (Characteristic Diagnostic Feature)
1. Burtonian line on gums
2. Blue/green coloration of vomitus
3. Aldrich-Mees lines on nails
4. Erethism and intentional tremors
Select the correct option from the codes given below:
(A) P-3, Q-1, R-4, S-2
(B) P-1, Q-3, R-2, S-4
(C) P-3, Q-4, R-1, S-2
(D) P-4, Q-1, R-3, S-2

35. Which of the following chemical tests is a specific confirmatory colour test for the presence of cyanide in biological fluids?
(A) Prussian blue test
(B) Classical Reinsch test
(C) Standard Marquis test
(D) Kastle-Meyer color test

36. Organophosphate pesticides cause severe toxicity in humans by irreversibly inhibiting the action of:
(A) Cytochrome oxidase
(B) Monoamine oxidase
(C) Acetylcholinesterase
(D) Sodium-potassium ATPase

37. The acronym SLUDGE (Salivation, Lacrimation, Urination, Defecation, Gastrointestinal distress, Emesis) is commonly used to describe the clinical symptoms of poisoning by:
(A) Organophosphates
(B) Organochlorine insecticides
(C) Heavy metal compounds
(D) Cyanogenic glycosides

38. How do carbamate pesticides primarily differ from organophosphate pesticides in their toxicological mechanism?
(A) Carbamates selectively inhibit mitochondrial cytochrome oxidase rather than synaptic acetylcholinesterase enzymes
(B) Carbamates act exclusively as central neurotoxins whereas organophosphates act purely as systemic hepatotoxins
(C) Carbamates bind completely irreversibly to cholinesterase, requiring hepatic synthesis of new enzyme for clinical recovery
(D) Carbamates cause reversible acetylcholinesterase inhibition, resulting in shorter toxicity

39. Organochlorine pesticides, such as DDT and Endrin, exert their primary toxic effect on humans by:
(A) Directly depressing the primary respiratory center located in the brain medulla
(B) Causing central nervous system stimulation and convulsions
(C) Inducing sudden irreversible cardiac arrest through massive myocardial infarction
(D) Producing severe and extreme systemic arterial cellular hypoxia

Click Here to Buy book on Amazon

40. In agricultural regions, tablets marketed under trade names like "Celphos" or "Quickphos" are frequently implicated in suicidal poisoning. What is the active toxic compound in these tablets?
(A) Highly concentrated zinc phosphide
(B) Organophosphate parathion
(C) Aluminium phosphide
(D) Organochlorine endosulfan

41. Aluminium phosphide exerts its lethal effect upon ingestion by reacting with stomach acid and moisture to release which highly toxic gas?
(A) Hydrogen cyanide gas
(B) Carbon monoxide gas
(C) Chlorine gas
(D) Phosphine gas

42. A simple and rapid preliminary test used in autopsy rooms to detect phosphine gas from stomach contents involves the use of filter paper soaked in:
(A) Silver nitrate solution
(B) Copper sulphate solution
(C) Potassium dichromate solution
(D) Barium chloride solution

43. Consider the following statements regarding Aluminium phosphide (AlP) poisoning:
I. Toxicity is due to the liberation of phosphine gas in the presence of moisture or gastric acid.
II. It typically produces a characteristic rotten egg odour in the stomach contents.
III. Severe hypotension and sudden cardiac collapse are the primary causes of death.
Which of the above statements is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

44. Endrin and Aldrin belong to which specific chemical class of agricultural poisons?
(A) Organophosphates
(B) Organochlorines
(C) Carbamates
(D) Pyrethroids

45. Which of the following drugs is administered as a specific physiological antidote to reverse the severe muscarinic symptoms in acute organophosphate poisoning?
(A) Atropine
(B) Naloxone hydrochloride
(C) Flumazenil injection
(D) Dimercaprol solution

46. Venom from snakes of the Elapidae family (such as cobras and kraits) is predominantly:
(A) Haemotoxic
(B) Myotoxic
(C) Neurotoxic
(D) Cardiotoxic

47. A person bitten by a Russell's viper is most likely to suffer from systemic complications due to the venom being primarily:
(A) Neurotoxic, causing respiratory paralysis
(B) Hepatotoxic, causing acute liver failure
(C) Nephrotoxic, selectively destroying renal tubules without other systemic effects
(D) Haemotoxic, causing extensive coagulopathy and tissue necrosis

48. The toxic action of Dhatura fastuosa is due to the presence of tropane alkaloids. Which of the following is the principal active alkaloid found in its seeds?
(A) Strychnine alkaloid
(B) Aconitine toxin
(C) Hyoscine
(D) Morphine sulphate

49. A patient is brought to the casualty ward presenting with symptoms characterized as "dry as a bone, red as a beet, blind as a bat, hot as a hare, and mad as a hatter." This clinical picture is classically diagnostic of poisoning by:
(A) Organophosphate pesticide toxicity
(B) Dhatura poisoning
(C) Cardiac oleander toxicity
(D) Spinal strychnine toxicity

50. The active toxic principles found in the leaves and roots of Nerium oleander (pink oleander) are chemically classified as:
(A) Tropane alkaloids
(B) Cyanogenic glycosides
(C) Toxalbumins
(D) Cardiac glycosides

51. The seeds of which plant are historically crushed, mixed with other materials, and fashioned into small needles known as "sui" or "sutari" for cattle poisoning?
(A) Abrus precatorius
(B) Ricinus communis
(C) Strychnos nux-vomica
(D) Calotropis procera

NODIA

52. The highly potent toxalbumin 'Ricin', which inhibits protein synthesis at the ribosomal level, is naturally found in the seeds of:
(A) Croton tiglium plant
(B) Abrus precatorius seeds
(C) Ricinus communis
(D) Semecarpus anacardium

53. Poisoning by Strychnos nux-vomica causes severe, painful tetanic convulsions. The active principle responsible for this action is:
(A) Strychnine
(B) Brucine
(C) Aconitine
(D) Both (A) and (B)

54. Match List I with List II.
List I: (Plant Poison)
P. Dhatura
Q. Abrus precatorius
R. Nux vomica
S. Castor
List II: (Principal Active Toxin)
1. Abrin
2. Ricin
3. Scopolamine
4. Strychnine
Select the correct option from the codes given below:
(A) P-3, Q-1, R-4, S-2
(B) P-1, Q-3, R-2, S-4
(C) P-3, Q-4, R-1, S-2
(D) P-4, Q-2, R-3, S-1

55. In the identification of snake bites, the presence of two distinct puncture wounds surrounded by local swelling and tissue necrosis is most indicative of a bite by a:
(A) Non-venomous constrictor
(B) Cobra or Viper
(C) Scorpion
(D) Centipede

56. What is the standard and most commonly used chemical preservative for storing viscera samples (stomach, liver, kidney) intended for toxicological analysis?
(A) 10% Neutral buffered formalin solution
(B) Pure glacial acetic acid chemical reagent
(C) Saturated sodium chloride solution
(D) Concentrated hydrochloric acid solution

57. Saturated sodium chloride solution is contraindicated as a viscera preservative if the suspected poison is:
(A) Metallic poisons like arsenic
(B) Organophosphate insecticides
(C) Alkaloids like strychnine
(D) Corrosive mineral acids

58. For the toxicological estimation of blood alcohol concentration, the recommended chemical preservative and anticoagulant combination added to the blood vial is:
(A) Sodium fluoride and oxalate
(B) Sodium chloride and heparin anticoagulant
(C) Formalin solution and disodium EDTA
(D) Rectified spirit and sodium citrate

59. Rectified spirit is generally an excellent preservative for viscera, but it must strictly be avoided in cases of suspected poisoning by:
(A) Heavy metals and organophosphates
(B) Phosphorus and alcohol
(C) Cyanide salts and strychnine
(D) Dhatura alkaloids and oleander

60. As per standard autopsy protocols, which internal organs are routinely collected as "viscera" for general toxicological analysis?
(A) Whole lungs, entire cardiac heart tissue, and cerebral brain hemisphere
(B) Stomach with contents, liver portion, and kidney halves
(C) Complete small intestine, entire spleen tissue, and whole pancreas
(D) Urinary bladder, internal reproductive organs, and thyroid gland

61. The classic Stas-Otto process is primarily utilized in forensic toxicology for the extraction of:
(A) Non-volatile organic poisons
(B) Volatile poisons including alcohol and cyanide
(C) Toxic heavy metals including arsenic and lead
(D) Strong corrosive inorganic mineral acids

62. Which of the following represents the correct sequential order of the major steps in the classical Stas-Otto process for the extraction of non-volatile organic poisons from viscera?
(A) Alcohol extraction, Evaporation, Aqueous extraction, Solvent partitioning
(B) Solvent partitioning, Alcohol extraction, Aqueous extraction, Evaporation

Downloaded from www.pdf.tube

by means of poison, etc., with intent to commit an offence"?
(A) Section 115
(B) Section 123
(C) Section 109
(D) Section 118

82. Which of the following is considered an ideal characteristic of a suicidal poison?
(A) It should be highly expensive, extremely rare, and difficult to acquire
(B) It should cause a slow, excruciatingly agonizing death to ensure success
(C) It should have an extremely foul taste to prevent accidental ingestion
(D) It is cheap, accessible, highly toxic, and painless

83. The "First-Pass Effect", which significantly reduces the active concentration of a poison before it reaches the systemic circulation, is most prominent when the poison is administered via which route?
(A) Oral
(B) Intravenous injection
(C) Inhalation route
(D) Subcutaneous injection

84. Match List I with List II.
List I: (Poison)
P. Cyanide
Q. Phosphorus
R. Alcohol
S. Endrin / Organochlorines
List II: (Characteristic Odour)
1. Garlicky
2. Bitter almonds
3. Fruity / Sweet
4. Petroleum-like
Select the correct option from the codes given below:
(A) P-2, Q-1, R-3, S-4
(B) P-1, Q-2, R-4, S-3
(C) P-2, Q-3, R-1, S-4
(D) P-4, Q-1, R-2, S-3

85. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Cyanide is extremely difficult to detect in viscera if the autopsy is delayed and advanced putrefaction has occurred.
Reason (R): Cyanide is a highly volatile chemical that rapidly evaporates, and it can also be naturally synthesized in trace amounts by putrefactive bacteria.
Select the correct answer from the options given below:
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

86. In cases of exhumation where the body has been buried for several years, which type of poison is most likely to still be detectable in the skeletal remains or surrounding soil?
(A) Synthetic organophosphate pesticides
(B) Highly volatile poisons like cyanide
(C) Complex plant alkaloids like strychnine
(D) Heavy metallic poisons

NODIA

87. Select the correct sequence of evidence handling procedures from the crime scene to the toxicological laboratory:
(A) Sealing & labelling → Collection → Dispatch with chain of custody → Laboratory accession
(B) Collection → Sealing & labelling → Dispatch with chain of custody → Laboratory accession
(C) Laboratory accession → Collection → Sealing & labelling → Dispatch with chain of custody
(D) Collection → Dispatch with chain of custody → Sealing & labelling → Laboratory accession

88. Consider the following statements regarding analytical instruments and their applications in toxicology:
I. GC-MS is the gold standard for confirming volatile and semi-volatile poisons.
II. Atomic Absorption Spectroscopy (AAS) is routinely used to quantify heavy metal poisons.
III. UV-Visible spectrophotometry provides a highly specific structural fingerprint of organic drugs.
IV. HPLC is preferred for analyzing thermally unstable compounds.
Which of the above statements are correct?
(A) I, II, and III only
(B) I, II, and IV only
(C) II, III, and IV only
(D) I, III, and IV only

STUDYING FROM PDFs?

THINK AGAIN.

If you are studying only from PDFs,
you are wasting valuable time.

Research shows that learning from

PRINTED BOOKS has up to

4× HIGHER RETENTION

than studying from screens.

PRINT BOOK = BETTER MEMORY

PDF = LOWER RETENTION

Those who study from **PRINTED BOOKS**
move **AHEAD.**

Others are left **BEHIND**
in competition.

In competitive exams,
being average is not enough.

STAY ONE STEP AHEAD.

elements
(D) Thermally labile or highly polar

74. Consider the following analytical procedures in forensic toxicology:
I. Confirmatory analysis using GC-MS or LC-MS
II. Maceration and extraction of the viscera
III. Presumptive screening using colour tests or TLC
IV. Physical examination and documentation of exhibits
Which of the following represents the correct sequential order from receipt of a toxicological exhibit to final report generation?
(A) IV, II, III, I
(B) II, IV, I, III
(C) IV, III, II, I
(D) I, II, III, IV

75. A forensic toxicologist is examining a liver extract using Thin Layer Chromatography. Which of the following statements is incorrect regarding this technique?
(A) TLC separates compounds based on their differential affinities for the stationary and mobile phases.
(B) An Rf value is a physical constant that alone provides absolute confirmatory identification of a poison in court.
(C) Visualisation of colourless drug spots on TLC plates often requires spraying with chromogenic reagents like Dragendorff's reagent.
(D) Silica gel G is one of the most commonly used materials for the stationary phase in TLC.

76. Consider the following statements regarding the diagnosis of poisoning in the dead:
I. Post-mortem hypostasis provides valuable clues, such as cherry-red lividity in CO poisoning.
II. The stomach mucosa may appear severely eroded and blackened in sulphuric acid poisoning.
III. Arsenic poisoning typically preserves the body, delaying putrefaction.
Which of the above statements are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

77. Consider the following statements about viscera preservation:
I. Saturated saline solution is the most common preservative used in India.
II. Rectified spirit is used when carbolic acid poisoning is suspected.
III. Blood samples for alcohol estimation require sodium fluoride to prevent microbial glycolysis.
IV. The quantity of preservative added should ideally be equal to the volume of the viscera.
Which of the above statements is/are incorrect?
(A) I and II only
(B) None; all statements are correct
(C) II and IV only
(D) III and IV only

78. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Sodium fluoride is added to blood samples collected for alcohol estimation.
Reason (R): Sodium fluoride inhibits the enzyme enolase, preventing post-mortem microbial fermentation that could alter the alcohol concentration.
Select the correct answer from the options given below:
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

79. Overdose of paracetamol, a commonly available analgesic medicine, primarily causes fatal toxicity by irreversible damage to the:
(A) Central nervous system tissue
(B) Cardiac myocardium muscles
(C) Red bone marrow cellularity
(D) Liver

80. Barbiturates and benzodiazepines, often encountered in medicinal overdose cases, belong to which functional class of neurotoxic drugs?
(A) Central nervous system stimulants
(B) Hallucinogenic agents
(C) CNS Depressants
(D) Deliriant neurotoxins

81. Under the Bharatiya Nyaya Sanhita (BNS) 2023, which section corresponds to Section 328 of the Indian Penal Code, dealing with "causing hurt

Click Here to Buy book on Flipkart

(C) Aqueous extraction, Solvent partitioning, Alcohol extraction, Evaporation
(D) Evaporation, Aqueous extraction, Solvent partitioning, Alcohol extraction

63. In the solvent partitioning step of liquid-liquid extraction, basic drugs (alkaloids) are predominantly extracted into the organic solvent phase when the aqueous phase is:
(A) Strongly acidic
(B) Strictly neutral
(C) Boiled vigorously
(D) Made alkaline

64. Solid-Phase Extraction (SPE) is widely replacing traditional liquid-liquid extraction in modern toxicology laboratories because SPE:
(A) Requires significantly larger volumes of toxic organic chemical solvents
(B) Selectively extracts only inorganic heavy metallic poisons from viscera
(C) Provides higher recovery with minimal solvent use
(D) Requires heating biological samples to temperatures over 500 degrees Celsius

65. When submitting stomach contents to the Forensic Science Laboratory for toxicological analysis in an adult poisoning death case, what is the standard recommended quantity of stomach contents that should be preserved?
(A) Exactly 10 ml
(B) The entire contents of the stomach
(C) Maximum of 50 ml
(D) Only the solid food particles, discarding the liquid

66. During preliminary screening, the Reinsch test is uniquely designed to detect the presence of which group of poisons in biological samples?
(A) Plant alkaloids and synthetic pharmaceutical drugs
(B) Volatile organic solvent compounds and gases
(C) Agricultural organophosphate pesticide compounds
(D) Heavy metals like arsenic and mercury

67. The visual confirmation in a positive Reinsch test occurs when the toxic metal deposits on the surface of a:
(A) Copper wire or foil
(B) Pure silver wire or foil
(C) Purified metallic zinc strip
(D) Polished platinum loop wire

NODIA

68. The Gutzeit test is an analytical chemical procedure utilized specifically for the detection of:
(A) Alcohol
(B) Cyanide
(C) Arsenic
(D) Barbiturates

69. The Marquis reagent, yielding a purple/violet colour change, is a common presumptive spot test used by forensic field officers to detect:
(A) Opiates
(B) Cannabis derivatives
(C) Pure cocaine alkaloid
(D) Organophosphate compounds

70. Immunoassay techniques (like ELISA) used in toxicological screening are fundamentally based on the specific biochemical interaction between:
(A) An acid and a base
(B) A metal ion and a chelating agent
(C) A stationary phase and a mobile phase
(D) An antigen and an antibody

71. In Thin Layer Chromatography (TLC), a common screening technique in toxicology, the Retardation factor (Rf) value of a poison is calculated as:
(A) Distance travelled by the solvent front divided by the distance travelled by the solute
(B) Distance travelled by the solute divided by the distance travelled by the solvent front
(C) Molecular weight of the solute divided by the distance travelled by the solvent front
(D) Time taken by the solute to separate divided by total run time

72. In Gas Chromatography (GC) used for detecting volatile poisons, the mobile phase is always a:
(A) Volatile organic liquid solvent
(B) Buffered aqueous polar solution
(C) Inert carrier gas
(D) Finely powdered solid silica gel

73. High-Performance Liquid Chromatography (HPLC) is highly preferred over Gas Chromatography (GC) for the analysis of certain poisons when the poison is:
(A) Highly volatile and easily vaporized organic compounds
(B) Low molecular weight gaseous substances
(C) Non-volatile inorganic heavy metallic

89. Consider the following statements regarding medico-legal scenarios in toxicology:

I. Administration of a stupefying drug to facilitate robbery is an offence under criminal law.

II. Medical practitioners are legally bound to inform the police if they suspect a case of homicidal poisoning.

III. Consent of the deceased's relatives is legally required in India before conducting a medico-legal autopsy in a suspected poisoning case.

Which of the above statements are correct?

(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

90. The major route of elimination for most soluble non-volatile poisons and their water-soluble metabolites from the human body is through the:

(A) Kidneys via urine
(B) Lungs via exhalation
(C) Skin via perspiration
(D) Liver via bile and feces

NODIA

www.nodia.in

ANSWERS

1. (B) First systematic classification of poisons based on physiological action and tissue damage
Mathieu Orfila published a landmark treatise on toxicity in 1814, establishing forensic toxicology as a distinct scientific discipline. He provided the earliest systematic classification of toxic substances based on their physiological effects and tissue damage. Furthermore, his research emphasized the necessity of chemical analysis to isolate and detect chemical substances within biological tissues.

2. (D) Any substance which, when introduced into or absorbed by a living organism, causes severe illness or death due to its chemical action
In legal and medical contexts, toxic substances are defined by their capacity to induce physiological harm through chemical interactions within living systems. A poison acts via molecular mechanisms rather than mechanical force or physical trauma. When absorbed, ingested, or introduced into a body, it alters vital biochemical pathways, causing severe disease, functional impairment, or fatality.

3. (A) Analysing biological exhibits to establish the presence and quantity of poisons for legal adjudication
Forensic toxicology operates at the intersection of analytical chemistry, pharmacology, and law enforcement. Within a forensic science laboratory, its primary responsibility involves examining biological tissues, fluids, and non-biological exhibits recovered during criminal investigations. Scientists isolate, identify, and quantify toxic agents to produce objective scientific evidence required for judicial proceedings and medico-legal investigations.

4. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Ingested or absorbed organic toxic compounds undergo rapid biotransformation upon entering systemic circulation, driven primarily by hepatic metabolic enzymes. This enzymatic degradation alters the parent molecular structure into distinct metabolic derivatives. Consequently, analytical toxicologists must target both unchanged compounds and their primary biotransformation products in biological viscera to ensure accurate detection and interpretation during laboratory investigations.

5. (A) Clinical Toxicology
Clinical toxicology focuses on the diagnosis, management, and prevention of poisoning cases in living individuals within medical settings. It addresses acute accidental ingestions, therapeutic drug overdoses, and occupational toxic exposures. Medical professionals utilize clinical toxicological principles to administer appropriate pharmacological antidotes, provide supportive medical care, and monitor physiological recovery in hospital emergency departments.

6. (D) Corrosive poisons
Corrosive agents are chemical compounds that induce extensive, immediate local destruction of living tissue upon direct contact. Strong inorganic acids like sulphuric acid and potent caustic alkalis like sodium hydroxide fall into this category. They act locally by coagulating tissue proteins or causing liquefaction necrosis, typically without requiring systemic absorption to cause severe tissue damage.

7. (B) Arsenic
Inorganic irritant substances cause localized inflammation, ulceration, and tissue damage upon contacting mucous membranes. Arsenic is a classic non-metallic inorganic element that produces severe gastrointestinal irritation and cellular harm. Unlike organic plant toxins or complex biological proteins, inorganic metallic and non-metallic irritants derive their cytotoxic properties directly from elemental or simple chemical structural configurations.

8. (C) Somniferous and spinal neurotoxins
Toxic agents targeting the central nervous system are classified according to their primary site of action and physiological effects. Central nervous system toxins include somniferous compounds like opium, which induce deep sleep or depression, and spinal neurotoxins like strychnine, which selectively target spinal cord motor pathways to produce severe reflex excitability and involuntary muscle spasms.

Downloaded from www.pdf.tube

9. (D) Nerium oleander
Nerium oleander contains potent cardiac glycosides, including oleandrin and neriine, which profoundly disrupt heart function. These active principles inhibit the cellular sodium-potassium adenosine triphosphatase pump, altering myocardial contractility and cardiac electrical conduction. Exposure leads to severe dysrhythmias, conduction blocks, and potential heart failure, making this plant a classic example of a natural cardiac toxin.

10. (A) Asphyxiants
Asphyxiants are toxic substances that impair cellular respiration and oxygen transport within the body. Carbon monoxide prevents effective oxygen binding to hemoglobin by forming carboxyhemoglobin, whereas hydrogen cyanide inhibits cytochrome c oxidase within cellular mitochondria. Both mechanisms severely restrict cellular utilization of oxygen, leading to rapid systemic hypoxia and profound tissue failure in critical organ systems.

11. (B) Corrosive poisons
Corrosive poisons exert intense localized chemical action that physically degrades and destroys cellular structures immediately upon application. Highly reactive chemical agents like concentrated acids and caustic bases cause rapid chemical burns, tissue sloughing, and ulceration. Their primary mode of damage occurs through direct contact reactions, independent of whether the chemical is absorbed into systemic circulation.

12. (A) P-2, Q-4, R-1, S-3
Chemical substances are categorized based on their toxic actions and sources. Nitric acid is a strong corrosive mineral acid causing direct tissue destruction. Arsenic is a classic inorganic non-metallic irritant causing systemic and local cellular damage. Strychnine acts as a spinal neurotoxin targeting motor neurons, while aconite acts as a potent cardiac toxin affecting myocardial sodium channels.

13. (A) I and II only
The severity and manifestation of toxicity depend heavily on biological and pharmacological variables. A victim's age, metabolic state, and preexisting health conditions dictate physiological susceptibility and clearance rates. Additionally, the administration route determines absorption speed and systemic bio-availability. Conversely, environmental factors such as the time of day a substance was synthesized have no bearing on its biological potency.

14. (C) Intravenous injection
Direct administration of a toxic substance into the venous bloodstream bypasses physiological absorption barriers and first-pass hepatic metabolism. This delivers the full active dose immediately into general circulation, resulting in near-instantaneous peak plasma concentrations. Consequently, intravenous administration produces the most rapid onset of severe toxic signs and symptoms compared to enteral, transdermal, or intramuscular pathways.

15. (A) II, I, IV, III
The pharmacokinetic progression of an ingested chemical follows a mandatory sequence through the body. The compound is first absorbed across biological membranes into the vascular circulation. It is then distributed throughout body tissues and fluids. Subsequently, hepatic enzymes metabolize the substance into metabolic derivatives, which are finally excreted from the organism via renal or biliary pathways.

16. (C) The dose lethal to 50% of a test animal population
The median lethal dose, abbreviated as LD50, is a standard quantitative metric in toxicology used to evaluate acute toxicity. It represents the statistically calculated mass of a substance required to cause mortality in fifty percent of a standardized experimental animal test population under defined conditions. Lower LD50 values correspond to higher chemical potency and toxicity levels.

NODIA

17. (B) Acute poisoning
Acute poisoning occurs when a living organism absorbs a significant, toxic dose of a chemical substance within a brief time frame or single exposure. This sudden exposure overwhelms physiological homeostatic mechanisms, precipitating rapid clinical deterioration and severe symptoms. It contrasts with chronic poisoning, which develops slowly through repeated low-dose exposures over prolonged operational periods.

incapable of hydrolyzing acetylcholine at synaptic junctions and neuromuscular endplates. The resulting excessive accumulation of acetylcholine hyperstimulates muscarinic and nicotinic receptors, precipitating severe cholinergic crisis across the autonomic and central nervous systems.

37. (A) Organophosphates
The mnemonic SLUDGE outlines the clinical manifestations of excessive muscarinic receptor stimulation caused by acetylcholinesterase inhibition. Organophosphate insecticides cause uncontrolled accumulation of acetylcholine at autonomic postganglionic parasympathetic nerve endings. This hyperstimulation triggers profuse salivation, lacrimation, urinary incontinence, gastrointestinal hypermotility resulting in defecation and severe cramps, alongside persistent emesis throughout affected systemic organs.

38. (D) Carbamates cause reversible acetylcholinesterase inhibition, resulting in shorter toxicity
Carbamate insecticides inhibit the acetylcholinesterase enzyme through carbamylation of its active site rather than phosphorylation. This chemical carbamate-enzyme bond spontaneously hydrolyzes much faster than the stable organophosphate-enzyme complex. Because carbamylation lacks irreversible aging phenomena, carbamate-induced acetylcholinesterase inhibition is rapidly reversible, leading to clinical toxicities that are generally less prolonged than those caused by organophosphates.

39. (B) Causing central nervous system stimulation and convulsions
Organochlorine insecticides like DDT and Endrin target neuronal membrane dynamics by interfering with sodium and potassium ion channels and inhibiting gamma-aminobutyric acid receptors. This disruption prevents normal repolarization and neuronal inhibition, producing generalized central nervous system hyperexcitability. Exposed individuals experience muscular twitching, severe tremors, central nervous system stimulation, and motor seizures or generalized tonic-clonic convulsions.

40. (C) Aluminium phosphide
Commercial grain fumigants formulated under trade names such as Celphos and Quickphos contain aluminium phosphide as their active toxic component. These solid pesticidal preparations are utilized extensively for grain preservation. Ingestion of these tablets releases highly toxic phosphine gas upon contact with aqueous environments, making aluminium phosphide one of the most common suicidal poisons encountered in agricultural regions.

41. (D) Phosphine gas
Aluminium phosphide undergoes rapid hydrolysis when exposed to moisture, aqueous solutions, or hydrochloric acid within the stomach. This chemical reaction liberates phosphine gas, a volatile protoplasmic poison. Phosphine gas rapidly diffuses into systemic circulation, inhibiting cytochrome oxidase enzymes, disrupting cellular oxidative metabolism, causing severe myocardial depression, and inducing profound, refractory shock throughout body tissues.

42. (A) Silver nitrate solution
A preliminary screening method for phosphine gas during post-mortem examination involves placing filter paper moistened with silver nitrate solution over gastric fluid or tissue samples. Liberated phosphine gas reduces silver nitrate to metallic silver, converting the moist paper from white to a dark brown or black color. This simple chemical test allows rapid preliminary detection of phosphine.

43. (C) I and III only
Aluminium phosphide toxicity stems from phosphine gas generation when the chemical reacts with gastric moisture or acid. The liberated phosphine inhibits cellular respiration, leading to profound myocardial injury, severe refractory hypotension, and cardiac collapse. However, phosphine gas emits a characteristic garlicky or decaying fish odor, rather than a rotten egg odor, making the second statement incorrect.

44. (B) Organochlorines
Endrin, Aldrin, Dieldrin, and Lindane belong to the cyclodiene and chlorinated hydrocarbon group of synthetic pesticides, classified as organochlorines. These synthetic substances are lipophilic compounds characterized by high

Click Here to Buy book on Amazon

Carboxyhemoglobin possesses a bright, distinctive pigment that alters the appearance of blood and cutaneous surfaces. Consequently, post-mortem hypostasis and organ vascular beds display a characteristic cherry-red coloration, providing forensic examiners with a prominent gross physical finding during autopsy examinations.

28. (B) Haemoglobin, forming carboxyhaemoglobin
Carbon monoxide exerts primary physiological toxicity through its high binding affinity for iron sites on hemoglobin molecules. It binds over two hundred times more effectively than oxygen, forming carboxyhemoglobin. This stable complex severely diminishes oxygen-carrying capacity and shifts the oxygen-hemoglobin dissociation curve, preventing adequate tissue oxygen delivery and inducing severe cellular hypoxia throughout the body.

29. (A) Cytochrome c oxidase
Cyanide acts as a potent cellular asphyxiant by binding directly to ferric iron ions within cytochrome c oxidase, the terminal enzyme complex of the mitochondrial electron transport chain. This binding completely halts oxidative phosphorylation, preventing cells from utilizing oxygen to generate adenosine triphosphate. Rapid intracellular energy failure occurs, causing swift, systemic cellular hypoxia and death.

30. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Carbon monoxide acts as a lethal asphyxiant because its binding affinity for human hemoglobin is roughly two hundred to two hundred fifty times greater than that of oxygen. Consequently, even minor atmospheric concentrations of this gas displace oxygen from hemoglobin molecules, rapidly forming carboxyhemoglobin and compromising systemic oxygen distribution, fully explaining its acute toxicity at low levels.

31. (D) Basophilic stippling of erythrocytes
Chronic lead poisoning, or plumbism, impairs intracellular heme synthesis pathways by inhibiting critical enzymes like pyrimidine 5'-nucleotidase and delta-aminolevulinic acid dehydratase. This inhibition leads to the accumulation of degraded ribosomal RNA aggregates within developing red blood cells. Under microscopic evaluation, these structural alterations appear as punctate blue inclusions, a phenomenon designated as basophilic stippling.

32. (C) Arsenic and mercury
British Anti-Lewisite, chemically designated as Dimercaprol, functions as a dithiol chelating agent designed to bind heavy metals. Its active sulfhydryl groups compete with intracellular tissue proteins for metallic cations, forming stable, non-toxic cyclic complexes. This chemical reaction promotes the mobilization and renal elimination of heavy metals, making it an effective pharmacological antidote for arsenic and mercury toxicities.

33. (B) Thallium
Monovalent thallium ions possess an ionic radius almost identical to that of potassium ions. Due to this physical similarity, thallium mimics potassium within biological systems, readily substituting for it in physiological cellular membrane pumps like the sodium-potassium ATPase. This substitution disrupts normal cellular electrical activity, enzymatic reactions, and essential metabolic processes across cardiac, nervous, and epithelial tissues.

34. (A) P-3, Q-1, R-4, S-2
Different heavy metals produce distinctive physical and neurological manifestations upon toxic exposure. Chronic arsenic poisoning causes fingernail keratin alteration known as Aldrich-Mees lines. Lead deposition along the gums creates a blue-black Burtonian line. Mercury exposure causes neurological erethism along with intentional tremors, while copper salts produce blue or green coloration in gastric emesis.

NODIA

35. (A) Prussian blue test
The Prussian blue reaction is a classic chemical test used to confirm the presence of cyanide ions in biological specimens. Distilled cyanide is treated with ferrous sulfate and ferric chloride under specific pH conditions, yielding a deep blue precipitate of ferric ferrocyanide. This characteristic color change offers unambiguous visual confirmation of cyanide ions within tested solutions.

36. (C) Acetylcholinesterase
Organophosphate compounds bind covalently to the active esteratic site of the acetylcholinesterase enzyme, causing phosphorylation of the enzyme complex. This binding renders the enzyme

18. (D) It should have a strong, repulsive taste and distinct color
Homicidal agents are typically selected to go unnoticed by the intended victim. An effective homicidal substance is odorless, tasteless, and colorless, allowing seamless incorporation into food or beverages without detection. It must also be potent in minimal quantities and mimic natural disease states. A repulsive taste or vivid color would immediately alert the victim, preventing ingestion.

19. (A) Croton oil
Croton oil is derived from the seeds of Croton tiglium, making it an organic irritant of plant origin rather than animal origin. In contrast, substances like cantharides, snake venom, and scorpion venom are biologically synthesized by animal species. Botanical irritants contain toxic plant principles such as phorbol esters that cause severe gastrointestinal and dermal irritation.

20. (A) I, II, and III only
Indigestible particulate materials like powdered glass act as mechanical irritants by lacerating tissue linings. Phosphorus represents a non-metallic inorganic irritant with toxic cellular effects. Barbiturates function as central depressants and somniferous agents. However, Dhatura contains anticholinergic alkaloids that act as deliriant cerebral neurotoxins, making its classification as a spinal neurotoxin completely inaccurate in biological toxicology.

21. (A) Aldrich-Mees lines
Chronic administration or exposure to inorganic arsenic impairs keratin synthesis within epidermal appendages, causing structural disturbances during fingernail growth. This disruption manifests visually as transverse, non-pigmented white bands across the nail beds, clinically termed Aldrich-Mees lines. These diagnostic bands move distally as the nail grows, providing key historical evidence of intermittent or prolonged toxic exposure.

22. (D) Methylmercury
Minamata disease is a severe neurological syndrome caused by chronic industrial methylmercury contamination. Methylmercury accumulates within aquatic food chains, leading to human ingestion via contaminated seafood. The organic mercury compound readily crosses the blood-brain barrier, causing localized neuronal necrosis. Clinical manifestations include severe cerebellar ataxia, constriction of visual fields, sensory loss, and central nervous system impairment.

23. (B) Lead
Prolonged systemic exposure to lead results in chronic plumbism, characterized by metabolic and physical abnormalities. Circulating lead reacts with sulfur compounds produced by oral bacteria, precipitating lead sulfide along the gingival tissue margins. This deposition forms a characteristic dark blue or black line, known as a Burtonian line, serving as a classic diagnostic sign during physical examinations.

24. (C) Copper sulphate
Acute ingestion of copper sulphate causes severe mucosal irritation and erosive gastritis within the digestive tract. The compound's intrinsic blue coloration, combined with gastric secretions and altered chemical states, imparts a distinctive blue or deep green color to the vomitus. This characteristic visual finding strongly indicates acute ingestion of copper salts during preliminary clinical and post-mortem evaluations.

25. (D) Thallium
Thallium toxicity produces a unique clinical combination of severe hair follicle disruption and peripheral nerve injury. It alters cellular protein synthesis and energy metabolism, resulting in widespread alopecia alongside intense, painful peripheral sensory neuropathy. The rapid onset of diffuse hair loss accompanied by painful paresthesias in lower extremities is a hallmark clinical indicator of thallium exposure.

26. (A) Cyanide
Hydrocyanic acid and volatile cyanide salts release a distinctive aroma classically described as resembling bitter almonds. During forensic autopsies, detecting this characteristic odor upon opening the abdominal cavity or stomach contents strongly points toward cyanide ingestion. Cyanide rapidly inhibits cellular respiration, making prompt sensory detection during initial post-mortem procedures an invaluable diagnostic clue for pathologists.

27. (B) Cherry red
Inhalation of carbon monoxide leads to high concentrations of carboxyhemoglobin circulating within blood vessels and tissues.

Downloaded from www.pdf.tube

chemical stability and environmental persistence. They induce toxic effects primarily through central nervous system hyperexcitability, altering voltage-gated ion channels and blocking inhibitory neurotransmitter pathways in neurological tissues.

45. (A) Atropine
Atropine acts as a competitive antagonist at muscarinic acetylcholine receptors. In cases of acute organophosphate toxicity, excessive acetylcholine hyperstimulates postganglionic parasympathetic sites. Administering atropine blocks these muscarinic receptors, effectively reversing life-threatening symptoms such as severe bronchorrhea, bronchospasm, bradycardia, and excessive glandular secretions, making it the primary physiological antidote during medical emergencies.

46. (C) Neurotoxic
Snakes belonging to the family Elapidae, including cobras, kraits, and mambas, produce venom containing potent neurotoxic polypeptides. These toxins target neuromuscular junction post-synaptic acetylcholine receptors or block pre-synaptic transmitter release. Clinical toxicity manifests as progressive flaccid paralysis, bilateral ptosis, respiratory muscle weakness, and fatal asphyxia if antivenom therapy and ventilatory support are not promptly initiated.

47. (D) Haemotoxic, causing extensive coagulopathy and tissue necrosis
Viperid envenomation, notably from Russell's viper, involves venom rich in procoagulant enzymes, hemorrhagins, and cytolysins. The venom activates clotting cascades, causing consumption coagulopathy, severe internal hemorrhaging, microvascular damage, and widespread tissue necrosis at the bite site. Systemic manifestations include bleeding from mucosal membranes, profound shock, and secondary acute kidney injury secondary to intravascular hemolysis.

48. (C) Hyoscine
Dhatura fastuosa seeds contain potent anticholinergic tropane alkaloids, primarily hyoscine, alongside atropine and hyoscyamine. Hyoscine acts as a competitive antagonist at central and peripheral muscarinic receptors. Its strong central nervous system effects lead to pronounced delirium, agitation, hallucination, memory impairment, and classic peripheral anticholinergic signs including pupillary dilation, dry skin, and tachycardia.

49. (B) Dhatura poisoning
The classic clinical phrase describes acute anticholinergic toxicity caused by plants like Dhatura. Tropane alkaloids block muscarinic receptors, suppressing sweat and salivary secretions to cause dry skin and thirst. Vasodilation causes facial flushing, loss of ocular accommodation produces blurred vision, central hyperthermia increases body temperature, and central neurotoxicity leads to acute deliriant mania and confusion.

50. (D) Cardiac glycosides
The pharmacological principles present in pink oleander, such as oleandrin and neriine, are structurally categorized as cardiac glycosides. These active botanical compounds possess cardiotoxic properties similar to digitalis. They inhibit myocardial cell membrane sodium-potassium ATPase, disrupting intracellular calcium homeostasis. Ingestion causes gastrointestinal distress, severe cardiac dysrhythmias, conduction disturbances, hyperkalemia, and potential cardiovascular failure.

51. (A) Abrus precatorius
Seeds of Abrus precatorius contain the potent toxalbumin abrin. Historically, powdered seeds are mixed with water, opium, or datura, then rolled into small sharp wooden or paste spikes called sui or sutari. These dried needles are inserted beneath the skin of cattle to induce lethal systemic toxicity, soft tissue swelling, and fatal organ damage.

NODIA

52. (C) Ricinus communis
Ricin is an extremely hazardous toxalbumin synthesized naturally within the seeds of Ricinus communis, commonly known as the castor oil plant. The toxin consists of two polypeptide chains linked by disulfide bonds. Chain B binds to cell surfaces, facilitating entry, while Chain A inactivates ribosomal RNA, completely halting cellular protein synthesis and causing cell death.

53. (D) Both (A) and (B)
The seeds of Strychnos nux-vomica contain two main indole alkaloids: strychnine and brucine. Both act as competitive antagonists at post-

72. (C) Inert carrier gas
Gas Chromatography relies on an inert carrier gas, such as helium, nitrogen, or hydrogen, to serve as the mobile phase. This non-reactive carrier gas transports vaporized chemical volatile analytes through a heated stationary phase capillary column. Separation occurs based on analyte boiling points and differential thermodynamic partitioning interactions between the carrier gas and column stationary phase.

73. (D) Thermally labile or highly polar
High-Performance Liquid Chromatography is the analytical method of choice for chemical substances that decompose at elevated temperatures or exhibit strong polarity. Because Gas Chromatography requires volatilization at high temperatures, thermally sensitive or highly polar non-volatile compounds tend to degrade. HPLC operates at lower liquid-phase temperatures, enabling stable separation and quantitative measurement of heat-sensitive toxic molecules.

74. (A) IV, II, III, I
Evidence processing follows a strict laboratory workflow. Forensic exhibits undergo physical logging, initial inspection, and visual documentation. Next, tissue samples undergo maceration and chemical extraction. Extracted samples then undergo presumptive spot tests or thin-layer chromatography screening. Finally, positive findings are confirmed using high-precision mass spectrometry techniques like GC-MS or LC-MS prior to report issuance.

75. (B) An Rf value is a physical constant that alone provides absolute confirmatory identification of a poison in court.
While Thin Layer Chromatography provides useful screening data, an Rf value is not an absolute physical constant and cannot serve as sole confirmatory evidence in legal proceedings. Environmental factors like room temperature, humidity, and chamber saturation cause slight Rf variations. Confirmatory legal identification requires mass spectrometry or multi-technique instrumental analysis to establish definitive molecular identification.

76. (D) I, II, and III
Post-mortem signs provide crucial toxicological clues. Carbon monoxide exposure causes characteristic cherry-red hypostasis. Ingestion of concentrated sulphuric acid produces severe, blackened mucosal erosion within the gastric lining due to dehydration and charring. Furthermore, chronic or acute arsenic exposure inhibits putrefactive bacterial growth, effectively mummifying or preserving soft body tissues and significantly delaying normal putrefaction.

77. (B) None; all statements are correct
All four statements regarding viscera preservation represent standard medico-legal principles. Saturated saline is the primary routine preservative used in India. Rectified spirit is substituted when carbolic acid is suspected to avoid interference. Sodium fluoride preserves blood alcohol by inhibiting glycolytic enzymes. Finally, equal volumes of preservative and tissue ensure adequate concentration to halt enzymatic putrefaction.

78. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Sodium fluoride is routinely added to post-mortem blood samples collected for alcohol estimation because it acts as a potent enzyme inhibitor. It specifically blocks the red blood cell and microbial enzyme enolase. This prevents post-collection microbial fermentation and glycolysis, which could artificially elevate measured ethanol levels, thereby explaining its essential role in sample preservation.

79. (D) Liver
Severe overdose of paracetamol (acetaminophen) leads to saturation of normal glucuronide and sulfate metabolic pathways. Excess paracetamol is bioactivated by hepatic cytochrome P450 enzymes into N-acetyl-p-benzoquinone imine, a highly reactive metabolite. Accumulation of this metabolite depletes intracellular hepatic glutathione, causing widespread oxidative stress, centrilobular hepatocellular necrosis, and acute liver failure.

80. (C) CNS Depressants
Barbiturates and benzodiazepines enhance central nervous system inhibition by acting on gamma-aminobutyric acid type A receptor complexes. These medicinal substances increase chloride ion influx, hyperpolarizing neuronal membranes and reducing electrical excitability. Consequently, they function as central nervous system depressants, producing clinical effects

Click Here to Buy book on Flipkart

precipitate proteins. The filtered alcoholic extract undergoes controlled evaporation. The resulting residue is reconstituted via aqueous extraction, after which liquid-liquid solvent partitioning under adjusted pH conditions separates organic poisons into immiscible solvent phases.

63. (D) Made alkaline
During liquid-liquid extractions, basic drugs like organic alkaloids exist in ionized, water-soluble forms in acidic solutions. Raising the pH of the aqueous phase using an alkaline reagent like ammonium hydroxide converts basic compounds into un-ionized, lipophilic free bases. These uncharged molecules readily partition out of the aqueous phase and dissolve into immiscible organic solvents for isolation.

64. (C) Provides higher recovery with minimal solvent use
Solid-Phase Extraction offers significant advantages over traditional liquid-liquid extraction in modern toxicological processing. SPE utilizes sorbent-packed cartridges to selectively retain target analytes while washing away matrix interferences. This method achieves higher analyte recovery rates, superior selectivity, and better reproducibility, while dramatically reducing processing time and organic solvent consumption compared to classical extraction techniques.

65. (B) The entire contents of the stomach
When collecting gastric evidence during medico-legal autopsies, forensic guidelines specify preserving the entire contents present inside the stomach cavity. Preserving the complete gastric volume ensures that the forensic laboratory can perform accurate quantitative calculations of the total ingested toxic dose. It also prevents sampling bias and provides sufficient material for multiple screening and confirmatory chemical tests.

66. (D) Heavy metals like arsenic and mercury
The Reinsch test serves as an effective preliminary screening procedure for detecting heavy metal poisons within biological samples. Under strongly acidic conditions, heavy metals such as arsenic, mercury, antimony, and bismuth deposit directly onto a clean metallic copper strip. This rapid screening test allows toxicologists to visually detect heavy metal contamination prior to quantitative instrumental analysis.

67. (A) Copper wire or foil
A positive outcome in the Reinsch preliminary test relies on an oxidation-reduction reaction occurring on the surface of bright copper foil or wire. Boiling biological specimens with hydrochloric acid in the presence of copper causes heavy metal ions to deposit as a distinct dark film, coating the copper surface and indicating metal contamination.

68. (C) Arsenic
The Gutzeit test is a sensitive chemical procedure specifically employed to detect trace quantities of arsenic in toxicological specimens. Arsenic present in the sample is reduced to volatile arsine gas using zinc and acid. The evolved gas reacts with mercuric chloride reagent paper, producing a characteristic yellow-to-brown stain whose intensity reflects arsenic concentration.

69. (A) Opiates
Marquis reagent, composed of formaldehyde mixed with concentrated sulphuric acid, is a widely used presumptive spot test reagent in forensic science. When added to suspected alkaloidal substances, it reacts with opium alkaloids such as morphine, codeine, and heroin to yield a distinctive purple or violet coloration, assisting field investigators and forensic analysts with rapid preliminary screening.

70. (D) An antigen and an antibody
Immunoassay techniques, including Enzyme-Linked Immunosorbent Assay, rely on the high specificity of biological binding interactions between an antigen and its corresponding antibody. In toxicological screening, target drug molecules act as antigens that bind selectively to specific antibody reagents, enabling sensitive detection and quantification of drugs and poisons within biological fluids like blood and urine.

71. (B) Distance travelled by the solute divided by the distance travelled by the solvent front
In Thin Layer Chromatography, the Retardation factor, or Rf value, measures the relative migration of a substance along the stationary phase. It is calculated quantitatively by dividing the distance traveled by the specific solute spot by the total distance traveled by the mobile solvent front from the baseline, providing a relative metric for compound comparison.

Downloaded from www.pdf.tube

pain, but highly dangerous in illicit markets due to its extreme potency?
(A) Heroin
(B) Buprenorphine
(C) Codeine
(D) Fentanyl

10. The Marquis test is a widely used presumptive colour test in forensic chemistry. What colour does the Marquis reagent turn when exposed to morphine or heroin?
(A) Purple-violet
(B) Bright blue
(C) Orange-brown
(D) Olive green

11. Match List I with List II and select the correct answer using the codes given below.
List I: (Drug Category)
P. Stimulant
Q. Hallucinogen
R. Depressant
S. Narcotic Analgesic
List II: (Example)
1. Psilocybin
2. Methadone
3. Methamphetamine
4. Diazepam
(A) P-3, Q-1, R-4, S-2
(B) P-1, Q-3, R-2, S-4
(C) P-3, Q-1, R-2, S-4
(D) P-4, Q-2, R-1, S-3

12. The psychoactive properties of the Cannabis sativa plant are primarily attributed to which compound?
(A) Cannabinol (CBN)
(B) Delta-9-THC
(C) Cannabidiol (CBD)
(D) Cannabichromene (CBC)

13. According to traditional Indian terminology, "Charas" refers specifically to which part or product of the Cannabis plant?
(A) The separated resin, whether crude or purified
(B) The dried leaves
(C) The flowering or fruiting tops of the female plant
(D) The crushed seeds and stems

14. Which presumptive test is specifically used for the identification of cannabis and its resin?
(A) Marquis test
(B) Dille-Koppanyi test
(C) Duquenois-Levine test
(D) Mandelin test

15. In the microscopic examination of cannabis leaves, which unique botanical feature is considered a highly characteristic identifying marker?
(A) Stellate trichomes
(B) Multi-cellular glandular scales
(C) Needle-like raphides
(D) Bear-claw shaped cystolithic hairs

16. Fast Blue B salt is frequently used as a chromogenic spray reagent in Thin Layer Chromatography (TLC). Which class of compounds is it primarily used to visualize?
(A) Opiate alkaloids
(B) Amphetamines
(C) Cannabinoids
(D) Barbiturates

17. Consider the following statements regarding the NDPS Act's definition of Cannabis (Hemp):
I. Charas is the separated resin obtained from the cannabis plant.
II. Ganja refers to the flowering or fruiting tops of the cannabis plant.
III. Bhang, made from the seeds and leaves when not accompanied by the tops, is heavily regulated and penalized identically to Charas under the core provisions of the NDPS Act.
Which combination of statements is correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

18. Cocaine is a powerful central nervous system stimulant naturally extracted from the leaves of which plant?
(A) Papaver somniferum
(B) Lophophora williamsii
(C) Catha edulis
(D) Erythroxylum coca

19. The Scott test is a standard field test for the presumptive identification of cocaine. What colour change is indicative of a positive result in the initial step of this test?
(A) Blue
(B) Purple
(C) Orange
(D) Red

NODIA

ranging from sedation and hypnosis to profound coma and respiratory depression in overdose.

81. (B) Section 123
Under the Bharatiya Nyaya Sanhita 2023, Section 123 covers the criminal offense of administering poison or other stupefying, intoxicating, or unwholesome substances with the intent to cause hurt or facilitate an offense. This statutory provision directly replaces Section 328 of the former Indian Penal Code, retaining legal penalties for criminal poisonings under updated Indian criminal jurisprudence.

82. (D) It is cheap, accessible, highly toxic, and painless
Substances chosen for suicidal purposes typically possess high lethality alongside easy accessibility and low financial cost. An ideal suicidal agent acts rapidly and painlessly, causing minimal suffering while ensuring death before medical intervention can occur. Highly painful, expensive, or rare chemicals are generally avoided by individuals seeking to end their own lives.

83. (A) Oral
Poisons ingested orally pass through the stomach and small intestine, absorbing directly into the hepatic portal venous circulation. This exposes the active compound to extensive hepatic metabolism before it reaches systemic circulation, a phenomenon termed the first-pass effect. This enzymatic metabolism significantly degrades and reduces the bioavailability of orally administered drugs compared to parenteral administration pathways.

84. (A) P-2, Q-1, R-3, S-4
Volatile aromas emitted by gastric contents or tissues assist in identifying specific toxic agents. Cyanide emits a classic bitter almond aroma. Phosphorus ingestion produces a distinctive garlicky odor alongside phosphorescence. Ethyl alcohol produces a sweet, fruity alcoholic breath odor, while organochlorine pesticide formulations release characteristic petroleum-like or solvent odors due to organic carriers.

85. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Detecting cyanide in putrefied viscera presents major analytical challenges because hydrocyanic acid is extremely volatile and rapidly escapes into ambient air. Furthermore, post-mortem bacterial putrefaction can produce endogenous trace amounts of cyanide or convert existing cyanide into thiocyanate. These factors complicate post-mortem evaluation in decomposed bodies, directly explaining why delayed autopsies hinder accurate cyanide detection.

86. (D) Heavy metallic poisons
Heavy metallic elements like lead, arsenic, mercury, and thallium are indestructible non-biodegradable inorganic entities. Unlike volatile compounds, organic pesticides, or complex plant alkaloids that break down over time due to microbial decomposition, metallic poisons persist indefinitely within skeletal bones, hair, nails, and surrounding grave soil, allowing reliable detection during exhumation cases years after burial.

87. (B) Collection → Sealing & labelling → Dispatch with chain of custody → Laboratory accession
Forensic evidence management requires a strict logical progression. Evidence is first gathered from the scene or post-mortem room. It is immediately sealed in tamper-evident packaging and labeled with case details. The evidence is dispatched along with documented chain of custody forms, culminating in official accessioning, logging, and storage upon arrival at the laboratory.

88. (B) I, II, and IV only
Gas Chromatography-Mass Spectrometry provides definitive confirmatory mass spectral identification. Atomic Absorption Spectroscopy precisely quantifies trace heavy metals. High-Performance Liquid Chromatography effectively handles heat-sensitive analytes. However, UV-Visible spectrophotometry yields broad absorption bands rather than definitive structural fingerprints, making the third statement incorrect regarding structural identification capabilities of analytical equipment.

89. (A) I and II only
Administering stupefying substances to facilitate crime is a punishable offense under criminal law, and medical professionals must legally report suspected homicidal poisonings to law enforcement authorities. However, in medico-legal autopsies ordered by investigating authorities like police officers or magistrates, family consent is not legally required under statutory criminal procedure provisions in India.

Click Here to Buy book on Amazon

90. (A) Kidneys via urine

The kidneys serve as the primary organ system responsible for eliminating water-soluble poisons and polar metabolic byproducts from human circulation. Glomerular filtration and tubular secretion filter circulating compounds out of blood plasma into renal tubules. These substances are concentrated and permanently excreted from the human body via urine, making renal elimination the dominant excretory pathway.

www.nodia.in

NODIA

CHAPTER 18

Drug Abuse, Narcotics and Alcohol Analysis

1. In the context of drug abuse, which of the following best defines the phenomenon of "tolerance"?
(A) The psychological desire to consume a drug to experience its euphoric effects
(B) A state where increasing doses of a drug are required to achieve the same physiological or psychological effect
(C) The manifestation of severe physical illness when drug administration is abruptly stopped
(D) The synergistic effect experienced when two different depressant drugs are consumed simultaneously

2. Which of the following drugs is primarily classified as a central nervous system depressant?
(A) Cocaine
(B) Amphetamine
(C) Lysergic acid diethylamide (LSD)
(D) Secobarbital

3. What is the primary difference between physical dependence and psychological dependence on a drug?
(A) Physical dependence is characterized by withdrawal symptoms upon cessation, whereas psychological dependence is the emotional compulsion to keep taking the drug.
(B) Physical dependence only occurs with synthetic drugs, while psychological dependence occurs with plant-based drugs.
(C) Physical dependence is treated with psychotherapy, whereas psychological dependence requires opioid replacement therapy.
(D) Physical dependence takes years to develop, whereas psychological dependence occurs immediately after a single dose.

4. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Heroin crosses the blood-brain barrier much faster than morphine.
Reason (R): The acetylation of morphine to form heroin makes the molecule highly lipophilic.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

5. The principal psychoactive alkaloid found in opium, responsible for its profound analgesic properties, is:
(A) Morphine
(B) Thebaine
(C) Papaverine
(D) Noscapine

6. Chemically, heroin is known as:
(A) Monoacetylmorphine
(B) Methylmorphine
(C) Ethylmorphine
(D) Diacetylmorphine

7. Which specific chemical reagent is primarily used in clandestine laboratories to convert morphine into heroin?
(A) Sodium hydroxide
(B) Acetic anhydride
(C) Potassium permanganate
(D) Hydrochloric acid

8. Codeine differs chemically from morphine due to the presence of which specific functional group at the C-3 position?
(A) An acetyl group
(B) A hydroxyl group
(C) A methoxy group
(D) A carboxyl group

9. Which of the following is a fully synthetic opioid, commonly used in medical settings for severe

Downloaded from www.pdf.tube

Reason (R): Both substances are central nervous system depressants and exert a synergistic respiratory depressant effect when taken together.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

32. Consider the following statements about Lysergic Acid Diethylamide (LSD):
I. It is active at microgram dosage levels.
II. It emits a characteristic strong odour.
III. It strongly fluoresces under ultraviolet light.
IV. It produces a blue-purple colour with Ehrlich's reagent.
Which combination of statements is correct?
(A) I, II, and III only
(B) I, III, and IV only
(C) II, III, and IV only
(D) I, II, III, and IV

33. Gold chloride ($HAuCl_4$) is frequently used in forensic chemistry to perform microcrystalline tests. Which of the following drugs yields highly characteristic X-shaped or cross-shaped crystals when treated with this reagent?
(A) Heroin
(B) Cocaine
(C) Amphetamine
(D) Cannabis

34. What is the fundamental principle behind microcrystalline tests for drugs?
(A) The drug is burned to ash and analyzed for crystalline structures using high-resolution X-ray diffraction techniques.
(B) The drug binds to a specialized fluorescent dye that forms crystalline complexes visible only under high-intensity UV light.
(C) The drug is dissolved in an organic solvent and passed through a micro-capillary column to isolate crystalline components.
(D) The drug reacts with a reagent to form characteristic crystalline precipitates observed under a polarized light microscope.

35. In Thin Layer Chromatography (TLC), the Rf (Retention factor) value is calculated as:
(A) Distance travelled by the solute divided by the distance travelled by the solvent front
(B) Distance travelled by the solvent front divided by the distance travelled by the solute
(C) The time taken by the solute to travel the plate divided by solvent migration time
(D) The peak area of the solute divided by the peak area of the internal standard

36. Which instrumental technique is considered the "gold standard" for the confirmatory identification of unknown drugs in forensic laboratories?
(A) Ultraviolet-Visible Spectroscopy (UV-Vis)
(B) High-Performance Thin Layer Chromatography (HPTLC)
(C) Gas Chromatography-Mass Spectrometry (GC-MS)
(D) Atomic Absorption Spectroscopy (AAS)

37. When analysing complex, thermally labile, or highly polar drug metabolites in biological fluids, which analytical technique provides a distinct advantage over GC-MS?
(A) Liquid Chromatography-Mass Spectrometry (LC-MS)
(B) Fourier Transform Infrared Spectroscopy (FTIR)
(C) Gas Chromatography with Flame Ionization Detection (GC-FID)
(D) Scanning Electron Microscopy (SEM)

38. Match List I with List II and select the correct answer using the codes given below.
List I: (Presumptive Test / Reagent)
P. Ehrlich's Reagent
Q. Mandelin Reagent
R. Dille-Koppanyi Reagent
S. Froehde Reagent
List II: (Substance Detected)
1. Barbiturates
2. LSD
3. Opioids (general)
4. Amphetamines/Strychnine
(A) P-2, Q-4, R-1, S-3
(B) P-1, Q-2, R-3, S-4
(C) P-4, Q-3, R-2, S-1
(D) P-2, Q-3, R-1, S-4

39. In Gas Chromatography (GC), the most commonly used inert carrier gas to transport the vaporized sample through the column is:
(A) Oxygen
(B) Helium
(C) Carbon dioxide
(D) Argon

NODIA

20. Which of the following chemicals is a heavily monitored precursor strictly regulated due to its use in the illicit synthesis of methamphetamine?
(A) Ergometrine
(B) Anthranilic acid
(C) Pseudoephedrine
(D) Piperonal

21. MDMA is a popular synthetic drug known for both its stimulant and mildly hallucinogenic effects. What is the full chemical name of MDMA?
(A) 3,4-Methylenedioxymethamphetamine
(B) 3,4-Methylenedioxyamphetamine
(C) 3-Methoxy-4-dimethylamphetamine
(D) Methoxy-dimethyl-methamphetamine

22. In the context of street drugs, MDMA is most commonly known by which of the following names?
(A) Speed
(B) Ice
(C) Smack
(D) Ecstasy

23. Lysergic acid diethylamide (LSD) is a potent hallucinogen originally synthesized from ergotamine. Ergotamine is naturally found in a fungus that grows on which grain?
(A) Wheat
(B) Rye
(C) Corn
(D) Barley

24. Select the correct order of reagents used in the three-step Scott test for cocaine:
(A) 1. Cobalt thiocyanate, 2. Hydrochloric acid, 3. Chloroform
(B) 1. Chloroform, 2. Cobalt thiocyanate, 3. Hydrochloric acid
(C) 1. Hydrochloric acid, 2. Chloroform, 3. Cobalt thiocyanate
(D) 1. Cobalt thiocyanate, 2. Chloroform, 3. Hydrochloric acid

25. The Dille-Koppanyi colour test is used to presumptively identify which class of sedative-hypnotic drugs?
(A) Benzodiazepines
(B) Phenothiazines
(C) Tricyclic antidepressants
(D) Barbiturates

26. Which functional neurotransmitter system is primarily enhanced by the action of benzodiazepines in the central nervous system?
(A) GABA
(B) Dopamine
(C) Serotonin
(D) Acetylcholine

27. "Spice" and "K2" are street names associated with which category of New Psychoactive Substances (NPS)?
(A) Synthetic cathinones
(B) Synthetic cannabinoids
(C) Piperazines
(D) Synthetic opioids

28. Chronic abuse of volatile inhalants such as toluene and trichloroethylene is most strongly associated with severe irreversible damage to which of the following?
(A) Skeletal muscle tissue architecture
(B) Myelin sheaths of the nervous system
(C) Pancreatic beta cell microstructures
(D) Gastric mucosal epithelial tissues

29. Simon's test is commonly used to differentiate methamphetamine from amphetamine. What chemical distinction does it rely on?
(A) The presence of a secondary amine in methamphetamine
(B) The presence of a primary amine in methamphetamine
(C) The absence of an aromatic ring in amphetamine
(D) The presence of a hydroxyl group in amphetamine

30. Which specific chemical reagent is commonly known as the Mecke reagent?
(A) A solution of ammonium vanadate in concentrated sulphuric acid
(B) A mixture of formaldehyde and concentrated sulphuric acid
(C) A solution of selenious acid in concentrated sulphuric acid
(D) A solution of molybdic acid in concentrated sulphuric acid

31. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): The combination of barbiturates and ethyl alcohol is highly dangerous and frequently fatal.

Click Here to Buy book on Flipkart

synaptic glycine receptors in the spinal cord and brainstem. By blocking this primary inhibitory neurotransmitter, these alkaloids allow unchecked spinal reflex motor firing, causing severe, painful tetanic muscle spasms and generalized tonic convulsions upon external stimulation.

54. (A) P-3, Q-1, R-4, S-2
Botanical poisons contain characteristic toxic chemical constituents. Dhatura fastuosa yields tropane alkaloids like scopolamine. Abrus precatorius seeds contain the ribosome-inactivating toxalbumin abrin. Strychnos nux-vomica seeds yield the spinal convulsant alkaloid strychnine, whereas seeds of the castor plant Ricinus communis produce the highly lethal cellular protein synthesis inhibitor ricin.

55. (B) Cobra or Viper
Venomous snakes possess specialized hollow or grooved maxillary fangs that produce distinct paired puncture wounds upon biting prey or humans. In contrast to non-venomous bites showing multiple small tooth marks, a bite from a cobra or viper leaves two clean fang punctures accompanied by local edema, pain, ecchymosis, and tissue destruction from injected venom components.

56. (C) Saturated sodium chloride solution
Saturated sodium chloride solution is the standard routine chemical preservative used across medico-legal autopsies for preserving viscera samples. It maintains high osmotic pressure, inhibiting bacterial growth and putrefactive degradation of tissues without chemically destroying organic or inorganic toxic substances. This preservation ensures that biological specimens remain intact for subsequent chemical extraction and analytical testing.

57. (D) Corrosive mineral acids
Saturated sodium chloride solution must not be added to viscera specimens when corrosive mineral acids, such as hydrochloric or sulphuric acid, are suspected. High concentrations of chloride ions from the salt interfere with analytical identification and quantitative estimations of acid radicals. In such cases, biological tissues should be preserved using alternative methods or kept unpreserved under refrigerated conditions.

58. (A) Sodium fluoride and oxalate
For forensic blood alcohol analysis, sodium fluoride is added as an essential enzyme inhibitor along with an anticoagulant such as potassium oxalate. Sodium fluoride specifically inhibits the glycolytic enzyme enolase, preventing post-mortem bacterial fermentation or enzymatic degradation of glucose into ethanol. This additive combination preserves true in vivo blood alcohol concentrations during specimen transport and laboratory analysis.

59. (B) Phosphorus and alcohol
Rectified spirit is a strong ethanol solution and cannot be used as a preservative when alcohol intoxication or phosphorus poisoning is suspected. Using ethanol solution would introduce exogenous alcohol, completely invalidating blood or tissue alcohol testing. Furthermore, ethanol dissolves elemental phosphorus, hindering its isolation and interfering with subsequent toxicological extraction and chemical identification procedures.

60. (B) Stomach with contents, liver portion, and kidney halves
Standard autopsy protocols dictate collecting specific organs during routine toxicological investigations. The stomach along with its unemptied contents is harvested to capture unabsorbed toxic substances. A representative portion of the liver, including the gallbladder, is collected due to major hepatic accumulation, while half of each kidney is retained to evaluate renal excretion and systemic drug distribution.

NODIA

61. (A) Non-volatile organic poisons
The classical Stas-Otto procedure is a foundational analytical extraction method designed to isolate non-volatile organic compounds from biological tissues. It utilizes systematic maceration, alcohol extraction, acid-base adjustments, and organic solvent partitioning. This multi-step chemical separation isolates non-volatile organic poisons, including plant alkaloids, synthetic pharmaceuticals, barbiturates, and pesticides, from complex tissue matrices for analytical identification.

62. (A) Alcohol extraction, Evaporation, Aqueous extraction, Solvent partitioning
The Stas-Otto extraction process follows a precise analytical sequence to isolate organic toxic compounds from viscera. Macerated biological tissue undergoes repeated alcohol extraction to

40. In a standard mass spectrum produced by electron ionization (EI) in GC-MS, the tallest peak in the spectrum is assigned an abundance of 100%. This peak is referred to as the:
(A) Molecular ion peak
(B) Isotope peak
(C) Base peak
(D) Fragment peak

41. Fourier Transform Infrared Spectroscopy (FTIR) is highly effective for identifying pure drug samples. What type of information does the IR spectrum primarily provide?
(A) The exact molecular weight and isotopic mass of the drug compound
(B) The precise isotopic composition and elemental ratios of the drug
(C) The number of protons and their specific resonance environments in the nucleus
(D) The functional groups and chemical bonds present in the molecule

42. What is a primary forensic advantage of using hair as a biological matrix for drug testing over urine or blood?
(A) Hair allows for a much longer window of detection, often spanning months.
(B) Hair provides a real-time measurement of current intoxication levels.
(C) Hair requires no specialized extraction procedures prior to GC-MS.
(D) Hair analysis avoids completely the issue of passive environmental contamination.

43. The average growth rate of human scalp hair, which is crucial for estimating the timeline of drug exposure in segmental hair analysis, is approximately:
(A) 1.0 to 1.3 centimetres per week
(B) 1.0 to 1.3 centimetres per month
(C) 1.0 to 1.3 millimetres per month
(D) 3.0 to 4.0 centimetres per month

44. In routine workplace drug testing programs, which analytical method is overwhelmingly used for the initial screening of urine samples?
(A) Gas Chromatography-Mass Spectrometry (GC-MS)
(B) Immunoassays (such as EMIT or ELISA)
(C) High-Performance Liquid Chromatography (HPLC)
(D) Thin Layer Chromatography (TLC)

45. To detect if a suspect has attempted to adulterate or dilute a urine sample prior to a drug test, toxicologists routinely measure which natural constituent of urine?
(A) Creatinine
(B) Glucose
(C) Bilirubin
(D) Uric acid

46. When collecting a blood sample from a living subject for forensic toxicological analysis (including alcohol and drugs), which chemical is typically added to the vial as an enzyme inhibitor to prevent in-vitro breakdown?
(A) Potassium oxalate
(B) Ethylenediaminetetraacetic acid (EDTA)
(C) Sodium fluoride
(D) Heparin

NODIA

47. Consider the following steps involved in the GC-MS analysis of a basic drug from a urine sample:
1. Derivatization of the extract
2. Liquid-liquid extraction using an organic solvent at alkaline pH
3. Injection into the Gas Chromatograph
4. Hydrolysis of conjugated drug metabolites

Which of the following represents the correct order?
(A) 2, 4, 1, 3
(B) 4, 2, 1, 3
(C) 1, 2, 4, 3
(D) 4, 1, 2, 3

48. Under the Narcotic Drugs and Psychotropic Substances (NDPS) Act, 1985, the punishment for an offence is often graduated based on the quantity of the drug involved. The categories are legally defined as:
(A) Minor, Major, and Extreme quantities
(B) Trace, Standard, and Bulk quantities
(C) Small, Intermediate, and Commercial quantities
(D) Personal use, Dealer, and Trafficker quantities

49. Consider the following statements regarding the mass spectrometry of drugs:
I. Electron Ionization (EI) is considered a "hard" ionization technique that typically produces extensive fragmentation.
II. Chemical Ionization (CI) is a "soft" technique more likely to show the intact protonated molecular ion.
III. The fragmentation pattern in an EI

(B) Permanent sensorineural loss of auditory hearing
(C) Instantaneous acute systemic bone marrow suppression
(D) Permanent visual blindness from optic nerve damage

71. In emergency medical treatment for acute methanol poisoning, intravenous ethanol is sometimes administered as an antidote. What is the pharmacological basis for this treatment?
(A) Ethanol chemically binds directly to methanol molecules in circulation, rapidly neutralizing systemic chemical toxicity.
(B) Ethanol outcompetes methanol for alcohol dehydrogenase, preventing formation of toxic metabolites.
(C) Ethanol acts as a potent renal diuretic, rapidly flushing unmetabolized methanol out through the urinary system.
(D) Ethanol directly reverses metabolic damage to the optic nerve and retinal tissues caused by toxic formaldehyde.

72. According to Section 185 of the Motor Vehicles Act, 1988, what is the legal threshold limit of Blood Alcohol Concentration (BAC) for drunken driving in India?
(A) 10 mg of alcohol per 100 ml of blood
(B) 30 mg of alcohol per 100 ml of blood
(C) 50 mg of alcohol per 100 ml of blood
(D) 80 mg of alcohol per 100 ml of blood

73. Which of the following terms describes ethanol that has been rendered unfit for human consumption by the addition of toxic or foul-tasting substances (such as methanol, pyridine, or denatonium benzoate)?
(A) Absolute alcohol
(B) Rectified spirit
(C) Proof spirit
(D) Denatured alcohol

74. In a forensic laboratory, a liquid sample suspected to be illicit liquor is analyzed. If the analyst adds a small amount of iodine and sodium hydroxide to the sample and a yellow precipitate with a distinct medicinal odour forms, which test is being performed?
(A) Iodoform test
(B) Marquis test
(C) Lucas test
(D) Fehling's test

75. Alcohol elimination from the human bloodstream generally follows zero-order kinetics. This implies that:
(A) Alcohol is eliminated at a fixed, constant fraction or percentage of total blood concentration per hour.
(B) Alcohol is eliminated at a constant mass per hour, independent of blood concentration.
(C) The rate of alcohol elimination increases exponentially as the circulating blood alcohol concentration rises.
(D) Alcohol elimination completely ceases once the total blood concentration falls below a threshold of 20 mg/100 ml.

76. In forensic toxicology, the term "designer drug" primarily refers to:
(A) High-end pharmaceutical medications stolen and sold on the black market
(B) Synthetic drug analogs modified chemically to evade legal controls
(C) Naturally occurring psychoactive plant extracts packaged in luxury branding
(D) Adulterants mixed with cocaine to increase its bulk and profit margin

77. Which of the following compounds is a Schedule I drug known for profound hallucinogenic properties and is typically administered on small squares of blotter paper?
(A) Lysergic acid diethylamide (LSD)
(B) Phencyclidine (PCP)
(C) Ketamine
(D) Gamma-hydroxybutyrate (GHB)

78. Select the correct order of the metabolic pathway of ethanol in the human body:
(A) Ethanol → Acetic acid → Acetaldehyde → Carbon dioxide + Water
(B) Ethanol → Acetaldehyde → Acetic acid → Carbon dioxide + Water
(C) Ethanol → Formaldehyde → Formic acid → Carbon dioxide + Water
(D) Ethanol → Acetone → Acetic acid → Carbon dioxide + Water

79. Match List I with List II and select the correct answer using the codes given below.
List I: (Concept/Test)
P. Widmark Formula
Q. Henry's Law
R. Iodoform Test
S. Duquenois-Levine Test
List II: (Description)

Downloaded from www.pdf.tube

(A) The ratio of body water to total body weight
(B) The rate of alcohol elimination per hour
(C) The ratio of alcohol in breath to alcohol in blood
(D) The specific gravity of the blood sample

62. In general, the Widmark factor 'r' is lower for females than for males. What physiological difference primarily accounts for this?
(A) Females metabolize ethyl alcohol significantly faster within the gastric mucosa lining.
(B) Females possess significantly higher baseline levels of hepatic alcohol dehydrogenase.
(C) Females have a higher proportion of body fat and lower total body water content.
(D) Females typically maintain a higher total blood volume per kilogram of body weight.

63. The physiological principle allowing the measurement of blood alcohol concentration via a breath sample is based on Henry's Law. In forensic breathalyzer calibration, the widely accepted blood-to-breath partition ratio at 34°C is:
(A) 1000 : 1
(B) 2100 : 1
(C) 3000 : 1
(D) 5000 : 1

64. Consider the following statements regarding the NDPS Act, 1985:
I. It prohibits the cultivation of the coca plant.
II. It allows for the controlled cultivation of opium poppy for medical and scientific purposes.
III. It completely bans the production of all synthetic opioid analgesics in India.
IV. Section 27 deals with punishment for the consumption of any narcotic drug or psychotropic substance.
Which combination of statements is correct?
(A) I, II, and III only
(B) I, II, and IV only
(C) II, III, and IV only
(D) I, III, and IV only

65. In older, chemically based breath testing instruments (like the original Breathalyzer), ethyl alcohol reacts with a specific chemical mixture, resulting in a colour change from orange to green. Which chemical undergoes this reduction?
(A) Potassium permanganate
(B) Potassium dichromate
(C) Silver nitrate
(D) Copper sulphate

66. Headspace Gas Chromatography is the standard technique for determining blood alcohol concentration in forensic laboratories. What is the fundamental principle of the "headspace" technique?
(A) Extracting ethyl alcohol using a non-polar organic solvent and injecting the isolated top solvent layer into the instrument
(B) Heating the whole blood sample until it completely vaporizes and injecting the entire gaseous mass directly into the column
(C) Filtering the cellular components of blood and injecting the clear supernatant plasma fraction directly into the GC column
(D) Measuring volatile alcohol molecules in the equilibrium gas phase above the liquid blood sample in a sealed vial

NODIA

67. In Headspace Gas Chromatography for ethanol analysis, an internal standard is routinely added to all samples and calibrators to ensure quantitative accuracy. Which of the following compounds is most commonly used as this internal standard?
(A) n-Propanol
(B) Methanol
(C) Ethylene glycol
(D) Acetaldehyde

68. The term "illicit liquor" or "hooch" tragedy frequently appears in Indian media, often resulting in mass casualties. These deaths are primarily caused by the adulteration of the liquor with which highly toxic chemical?
(A) Isopropyl alcohol
(B) Ethylene glycol
(C) Methanol
(D) Acetone

69. Methanol is extremely toxic because the enzyme alcohol dehydrogenase metabolizes it into which two highly dangerous compounds?
(A) Formaldehyde and formic acid
(B) Acetaldehyde and acetic acid
(C) Acetone and propionic acid
(D) Butyraldehyde and butyric acid

70. A clinical hallmark and specific severe toxic effect of methanol poisoning in survivors is:
(A) Severe localized subcutaneous tissue and skin necrosis

temperature prior to sampling.
Reason (R): According to Henry's Law, the distribution of alcohol between the liquid blood phase and the gaseous headspace is highly temperature-dependent.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

88. Consider the following statements regarding the testing of hair for drugs of abuse:
I. Darker hair typically binds higher concentrations of basic drugs, such as cocaine, compared to lighter hair.
II. Hair analysis is particularly useful in drug-facilitated sexual assault cases when reporting is delayed for several weeks.
III. A single use of a drug is easily and reliably detected in hair analysis regardless of the drug dosage.
Which combination of statements is correct?
(A) I and II only
(B) I and III only
(C) II and III only
(D) I, II, and III

89. Match List I with List II and select the correct answer using the codes given below.
List I: (NDPS Narcotic/Psychotropic Drug)
P. Heroin
Q. Cocaine
R. Ganja
S. MDMA
List II: (Commercial Quantity under NDPS Act)
1. 100 grams
2. 20 kilograms
3. 250 grams
4. 10 grams
(A) P-3, Q-1, R-2, S-4
(B) P-1, Q-3, R-2, S-4
(C) P-3, Q-4, R-2, S-1
(D) P-2, Q-1, R-3, S-4

90. Arrange the standard operating procedures for handling a suspected white powder drug exhibit at a crime scene in the correct chronological order:
1. Conduct a presumptive field colour test on a minute sampling.
2. Photograph and document the exact location and condition of the powder.
3. Forward the sealed exhibit to the Forensic Science Laboratory with a proper forwarding letter.
4. Carefully transfer the powder into an appropriate container, seal, and sign it for chain of custody.
Which of the following represents the correct chronological order?
(A) 2, 4, 1, 3
(B) 1, 2, 4, 3
(C) 2, 1, 4, 3
(D) 4, 2, 1, 3

www.nodia.in

Click Here to Buy book on Amazon

1. Principle behind breath alcohol analysis
2. Identification test for marijuana
3. Used for estimation of blood alcohol based on consumption
4. Chemical test identifying presence of ethanol

(A) P-3, Q-1, R-4, S-2
(B) P-1, Q-3, R-2, S-4
(C) P-3, Q-4, R-1, S-2
(D) P-4, Q-1, R-3, S-2

80. Identify the incorrect statement regarding the forensic examination of hairs for drugs of abuse:
(A) Drugs enter the hair shaft primarily via passive diffusion from blood capillaries supplying the hair follicle.
(B) Segmental sectioning of hair along its length provides a detailed chronological timeline of historical drug use.
(C) External environmental exposure cannot cause false positive results in hair drug testing.
(D) The melanin pigment content in human hair significantly influences the incorporation rate of basic drugs.

81. In the context of drug testing via biological matrices, which matrix is generally considered the best indicator of very recent drug use (i.e., within the past few hours)?
(A) Scalp hair tissue
(B) Oral fluid (Saliva)
(C) Nail clippings
(D) Femoral bone marrow

82. Which of the following statements best describes the pharmacological phenomenon of "cross-tolerance"?
(A) When tolerance developed toward one drug causes an increased physiological sensitivity to a completely different class of drug
(B) When a drug molecule is simultaneously and completely metabolized by two distinct physiological organ systems at equal rates
(C) When an individual alternates between a central nervous system stimulant and depressant to systematically balance their clinical effects
(D) When tolerance to one drug reduces physiological response to another drug in the same class

83. The term "proof" is traditionally used to denote the strength of alcoholic beverages. In the standard US system, if a whiskey is labelled as "80 proof", what is its percentage of alcohol by volume (ABV)?
(A) 20%
(B) 40%
(C) 80%
(D) 100%

84. "Roofies" or "Date Rape Drug" are colloquial terms most commonly associated with which powerful, fast-acting benzodiazepine?
(A) Diazepam
(B) Alprazolam
(C) Flunitrazepam
(D) Lorazepam

85. Consider the following statements about methanol poisoning:
I. Methanol itself is relatively non-toxic; its danger lies entirely in its metabolites.
II. The accumulation of formic acid leads to a severe metabolic acidosis.
III. Fomepizole can be used as a specific antidote because it inhibits alcohol dehydrogenase.

Which combination of statements is correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

NODIA

86. Consider the following statements regarding New Psychoactive Substances (NPS) and Designer Drugs:
I. They are structurally modified to circumvent existing drug control laws.
II. "Bath salts" generally contain synthetic cathinones like mephedrone or MDPV.
III. Synthetic cannabinoids act on the same cellular receptors as THC but are often much more potent.
IV. Standard immunoassay drug screening tests can easily and reliably detect all modern NPS variations.

Which combination of statements is correct?
(A) I, II, and III only
(B) I, III, and IV only
(C) II, III, and IV only
(D) I, II, III, and IV

87. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): In headspace gas chromatography for blood alcohol analysis, the sample vial is heated to a strictly controlled, constant

27. (B) Synthetic cannabinoids
Spice and K2 are common commercial brand names for synthetic cannabinoid products belonging to the new psychoactive substances category. These designer chemicals are laboratory-synthesized compounds sprayed onto inert dried plant material. They function as full, high-affinity agonists at CB1 and CB2 cannabinoid receptors, producing unpredictable, highly intense toxicological effects compared to natural cannabis.

28. (B) Myelin sheaths of the nervous system
Chronic recreational inhalation of volatile organic solvents, such as toluene, xylene, and trichloroethylene, causes extensive neurotoxic damage to the central and peripheral nervous systems. These lipophilic volatile compounds readily cross nerve cell membranes, triggering lipid peroxidation and progressive destruction of the protective myelin sheaths surrounding axons, leading to leukoencephalopathy and permanent neurological deficits.

29. (A) The presence of a secondary amine in methamphetamine
Simon's test is a colorimetric spot test utilized to differentiate secondary amines from primary amines. Methamphetamine contains a N-methyl group, making it a secondary amine, whereas amphetamine is a primary amine. Upon reaction with sodium nitroprusside, acetaldehyde, and sodium carbonate, secondary amines like methamphetamine produce a brilliant blue color, while primary amines yield pink or colorless results.

30. (C) A solution of selenious acid in concentrated sulphuric acid
The Mecke reagent is a qualitative chemical spot test prepared by dissolving selenious acid in concentrated sulfuric acid. Used extensively in forensic toxicology, this reagent produces characteristic color changes when exposed to various alkaloids and synthetic drugs. It is particularly useful for presumptively identifying opiates and phenethylamines through oxidation and condensation reactions yielding distinctive chromatic patterns.

31. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Combining barbiturates with ethanol creates severe clinical dangers due to supra-additive pharmacological synergism. Both agents potentiate neuroinhibitory signals by enhancing GABA-A receptor function in the central nervous system through distinct binding sites. Co-ingestion leads to profound brainstem depression, severely suppressing respiratory drive centers and frequently causing fatal hypoventilation, respiratory arrest, and coma at lower dosages.

32. (B) I, III, and IV only
Lysergic acid diethylamide is an odorless, tasteless ergoline derivative that exhibits extreme potency at microgram thresholds. Because of its conjugated indole ring system, the molecule fluoresces brightly under long-wavelength ultraviolet illumination. Additionally, exposure to Ehrlich's reagent, containing p-dimethylaminobenzaldehyde in acid solution, forms a characteristic blue-purple chromophore indicative of indole structures.

33. (B) Cocaine
Microcrystalline testing of cocaine using aqueous gold chloride solution yields distinct, highly reproducible crystalline precipitates. When cocaine base or hydrochloride reacts with five percent gold chloride reagent on a microscope slide, it rapidly forms characteristic long, delicate yellow crystals shaped as distinctive X-shapes, cross-shapes, or delicate serrated feathers visible under polarized light microscopy.

34. (D) The drug reacts with a reagent to form characteristic crystalline precipitates observed under a polarized light microscope.
Microcrystalline testing is a classical microchemical identification technique. The process involves adding a drop of specialized chemical reagent directly to a dissolved sample of an unknown substance. The reagent reacts with target drug molecules to precipitate microscopic crystals possessing specific, highly reproducible geometric shapes, habits, and optical properties that are observed under polarized light.

35. (A) Distance travelled by the solute divided by the distance travelled by the solvent front
In thin-layer chromatography, the retention factor, or Rf value, is a dimensionless physical constant used to quantify substance migration. It is defined mathematically as the ratio of the distance migrated by the individual solute spot from the origin to the total distance migrated by

Downloaded from www.pdf.tube

ANSWERS

1. (B) A state where increasing doses of a drug are required to achieve the same physiological or psychological effect
Drug tolerance is a pharmacological concept describing a decreased responsiveness to a substance following repeated administration. As neurochemical receptors undergo desensitization or downregulation, higher concentrations of the drug become necessary to elicit the initial therapeutic, physiological, or psychological intensity. This neuroadaptation forces users to escalate dosage levels continually to reach the desired functional outcomes over time.

2. (D) Secobarbital
Secobarbital belongs to the barbiturate class of pharmaceutical drugs, which act as potent central nervous system depressants. These substances enhance the inhibitory action of gamma-aminobutyric acid at GABA-A receptor sites in the brain. This neurochemical action depresses neuronal activity, resulting in sedation, hypnosis, reduced anxiety, and motor coordination impairment depending on the administered dosage.

3. (A) Physical dependence is characterized by withdrawal symptoms upon cessation, whereas psychological dependence is the emotional compulsion to keep taking the drug.
Physical dependence represents an adaptive physiological state where body systems adapt to drug presence, manifesting measurable physical withdrawal symptoms upon abrupt cessation. Conversely, psychological dependence involves a persistent mental or emotional craving and compulsive drive to use a substance for pleasure or stress relief, without necessarily involving acute physical withdrawal disturbances when administration is stopped.

4. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Morphine contains two hydrophilic hydroxyl groups, making it relatively slow to cross the lipid-rich blood-brain barrier. The chemical process of diacetylation converts these hydroxyl groups into ester linkages, yielding heroin. This structural alteration dramatically increases the lipophilicity of the molecule, allowing rapid uptake into central nervous system tissue, where it is rapidly metabolized into active morphine derivatives.

5. (A) Morphine
Morphine is the primary active phenanthrene alkaloid present in crude opium exudate harvested from the opium poppy. It functions as a potent agonist at mu-opioid receptors within the central nervous system. This molecular interaction inhibits pain signaling pathways, producing powerful analgesic and sedative therapeutic effects, while also carrying a high liability for physiological dependence and addiction.

6. (D) Diacetylmorphine
Heroin is a semi-synthetic opioid produced by the chemical acetylation of natural morphine using acetic anhydride or acetyl chloride. This synthetic reaction attaches two acetyl functional groups to the 3-O and 6-O positions of the morphine skeleton, yielding diacetylmorphine. The addition of these acetyl moieties enhances the compound's lipophilic properties compared to parent morphine.

7. (B) Acetic anhydride
In illicit laboratory processing, acetic anhydride is the primary chemical acetylating agent employed to convert morphine base into diacetylmorphine. The reagent reacts with the hydroxyl groups at the C-3 and C-6 positions of the morphine molecule under heat. Because of its essential role in illicit heroin production, acetic anhydride is strictly controlled internationally as a precursor.

8. (C) A methoxy group
Codeine and morphine share a structurally identical phenanthrene core, but differ at the phenolic C-3 carbon position. In morphine, C-3 holds a free hydroxyl group, whereas in codeine, this group is methylated to form a methoxy group, making codeine 3-methylmorphine. This structural modification reduces its binding affinity for mu-opioid receptors, resulting in lower analgesic potency.

NODIA

9. (D) Fentanyl
Fentanyl is a fully synthetic phenylpiperidine opioid analgesic with an extremely rapid onset and high potency, approximately fifty to one hundred times greater than morphine. Primarily synthesized for clinical pain management and anesthesia, its high potency makes minute quantities extraordinarily lethal, presenting severe toxicological hazards when distributed illicitly as a standalone powder or mixture in street drugs.

10. (A) Purple-violet
The Marquis test is a qualitative chemical spot test composed of formaldehyde dissolved in concentrated sulfuric acid. When exposed to opiates containing a phenanthrene nucleus, such as morphine, codeine, or heroin, a condensation reaction produces a protonated dimer complex. This reaction yields an immediate and distinctive purple-violet colour, confirming the presumptive presence of alkaloid substances.

11. (A) P-3, Q-1, R-4, S-2
Psychoactive substances are classified according to their primary pharmacological actions on the central nervous system:

Methamphetamine functions as a potent central nervous system stimulant.

Psilocybin is a naturally occurring tryptamine hallucinogen.

Diazepam belongs to the benzodiazepine class of central nervous system depressants.

Methadone is a synthetic opioid acting as a narcotic analgesic.

12. (B) Delta-9-THC
The principal psychoactive constituent of Cannabis sativa is delta-9-tetrahydrocannabinol. This lipid-soluble cannabinoid binds directly to central CB1 cannabinoid receptors located throughout the brain, altering neurotransmitter release. While cannabis contains numerous non-psychoactive cannabinoids like cannabidiol and cannabinol, delta-9-tetrahydrocannabinol is predominantly responsible for producing the characteristic intoxicating, cognitive, and physiological effects associated with cannabis consumption.

13. (A) The separated resin, whether crude or purified
In traditional Indian terminology and statutory drug classifications, Charas refers specifically to the pure or crude resinous exudate harvested from the flowering tops of the female cannabis plant. Obtained through physical rubbing or solvent extraction of live plants, Charas contains the highest concentration of active cannabinoid compounds, distinguishing it legally from dried leaves or isolated tops.

14. (C) Duquenois-Levine test
The Duquenois-Levine reagent is a specialized chemical spot test designed for the presumptive identification of cannabis products. The test utilizes vanillin and acetaldehyde in ethanol, followed by concentrated hydrochloric acid and chloroform extraction. A positive result produces a purple or violet color in the lower organic chloroform layer, confirming the presence of lipophilic cannabinoid compounds.

15. (D) Bear-claw shaped cystolithic hairs
Microscopic examination of Cannabis sativa leaves reveals characteristic unicellular non-glandular trichomes known as cystolithic hairs. These unique structural formations are curved, claw-like or bear-claw shaped, and contain a prominent deposit of calcium carbonate at their bulbous base. Their distinct morphology, coupled with effervescence upon adding dilute acid, provides an unmistakable botanical diagnostic marker for cannabis identification.

16. (C) Cannabinoids
Fast Blue B salt, chemically known as o-dianisidine tetrazotized, is a chromogenic diazotization reagent used in thin-layer chromatography. It reacts specifically with phenolic structures present in cannabinoids, such as delta-9-tetrahydrocannabinol, cannabidiol, and cannabinol. Upon spraying, it forms distinctively colored azo dyes, enabling precise visual localization and differentiation of cannabinoid spots on chromatographic plates.

17. (A) I and II only
Under the Narcotic Drugs and Psychotropic Substances Act, cannabis resin is legally classified as Charas, and the flowering or fruiting tops are categorized as Ganja. Bhang, derived exclusively from the leaves and seeds without flowering tops, is excluded from the primary statutory definition of cannabis hemp under the central legislation, placing it under separate state revenue regulations.

Click Here to Buy book on Flipkart

18. (D) Erythroxylum coca
Cocaine is a naturally occurring tropane alkaloid extracted from the leaves of Erythroxylum coca, a plant species indigenous to western South America. The botanical matrix contains several related alkaloids, but cocaine is the predominant psychoactive substance isolated. It functions pharmacologically as a central nervous system stimulant by inhibiting the reuptake of dopamine, norepinephrine, and serotonin.

19. (A) Blue
The Scott test is a three-step presumptive field test for cocaine. In the first step, the sample is mixed with a solution of two percent cobalt thiocyanate dissolved in water and glycerine. The formation of a distinctive blue precipitate or blue solution in this initial stage indicates the potential presence of cocaine or related tropane bases.

20. (C) Pseudoephedrine
Pseudoephedrine is a sympathomimetic amine commonly present in over-the-counter decongestant medications that serves as a principal chemical precursor for the clandestine manufacture of methamphetamine. Through simple chemical reduction processes, such as the Birch reduction or hydriodic acid method, pseudoephedrine is converted directly into methamphetamine, making its sale and distribution heavily monitored by regulatory authorities.

21. (A) 3,4-Methylenedioxymethamphetamine
MDMA stands for 3,4-methylenedioxymethamphetamine, a synthetic ring-substituted phenethylamine derivative. Its chemical structure combines structural elements of classical amphetamines with mescaline-like hallucinogens. This unique molecular configuration allows MDMA to act simultaneously as a central nervous system stimulant and an empathogen-entactogen by triggering substantial releases of serotonin, dopamine, and norepinephrine in synaptic clefts throughout the brain.

22. (D) Ecstasy
In illicit drug markets and street nomenclature, 3,4-methylenedioxymethamphetamine is most widely known as Ecstasy. Typically distributed in compressed tablet form featuring distinctive stamped logos or symbols, Ecstasy is consumed recreationally for its entactogenic, euphoric, and stimulant properties. Other common street designations for crystalline or powder forms of MDMA include Molly, Adam, or Clarity.

23. (B) Rye
Lysergic acid diethylamide is a potent semi-synthetic ergoline hallucinogen derived from ergotamine, an alkaloid produced by the fungus Claviceps purpurea. This parasitic fungus infects cereal grains, most notably rye crops, causing ergotism upon ingestion. Chemical hydrolysis of ergotamine yields lysergic acid, which is subsequently converted into diethylamide derivatives in laboratory settings.

24. (A) 1. Cobalt thiocyanate, 2. Hydrochloric acid, 3. Chloroform
The Scott test utilizes three sequential reagents to presumptively identify cocaine base or hydrochloride:

First, cobalt thiocyanate yields a blue precipitate.

Second, adding concentrated hydrochloric acid dissolves the precipitate, turning the solution pink.

Third, adding chloroform extracts the complex into the lower layer, returning a intense blue colour confirming cocaine.

25. (D) Barbiturates
The Dille-Koppanyi test is a specialized colorimetric spot test used in forensic chemistry to detect barbiturates. The reagent consists of cobalt acetate dissolved in methanol, followed by isopropylamine. When exposed to substances containing the imide group characteristic of the barbiturate ring structure, a coordination complex forms, yielding a distinct violet or purple color reaction.

26. (A) GABA
Benzodiazepines exert their central nervous system effects by binding selectively to allosteric sites on GABA-A receptor complexes. This binding increases the frequency of chloride channel opening in response to gamma-aminobutyric acid, the primary inhibitory neurotransmitter. The resulting influx of chloride ions hyperpolarizes post-synaptic neurons, producing sedative, anxiolytic, muscle-relaxant, and anticonvulsant pharmacological responses across the central nervous system.

Downloaded from www.pdf.tube

mass spectrum serves as a highly specific "fingerprint" for identifying a molecule.

Which combination of statements is correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

50. What is the defined "small quantity" for Heroin under the official notifications of the NDPS Act in India?
(A) 2 grams
(B) 5 grams
(C) 10 grams
(D) 50 grams

51. What is the defined "commercial quantity" for Charas (Hashish) under the NDPS Act?
(A) 100 grams
(B) 500 grams
(C) 1 kilogram
(D) 20 kilograms

52. The nodal central agency in India primarily responsible for the enforcement of the provisions of the NDPS Act is the:
(A) Central Bureau of Investigation (CBI)
(B) National Investigation Agency (NIA)
(C) Narcotics Control Bureau (NCB)
(D) Directorate of Revenue Intelligence (DRI)

53. Chemically, the alcohol present in consumable alcoholic beverages is:
(A) Ethanol
(B) Methanol
(C) Isopropanol
(D) Ethylene glycol

54. During the biological fermentation of sugars to produce alcohol, yeast acts upon glucose under anaerobic conditions to yield ethanol and which other primary byproduct?
(A) Molecular oxygen
(B) Lactic acid
(C) Acetic acid
(D) Carbon dioxide

55. The maximum concentration of ethanol that can typically be achieved by natural yeast fermentation before the yeast dies from alcohol toxicity is approximately:
(A) 5 to 7 %
(B) 14 to 16 %
(C) 25 to 30 %
(D) 40 to 45 %

56. Following oral consumption, the majority (about 80%) of ethyl alcohol is absorbed into the bloodstream from which part of the gastrointestinal tract?
(A) Stomach
(B) Large intestine
(C) Small intestine
(D) Esophagus

57. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Immunoassays used for preliminary drug screening must always be confirmed by a secondary technique like GC-MS.
Reason (R): Immunoassays are prone to cross-reactivity with structurally similar, legally consumed compounds, leading to false positives.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

NODIA

58. The primary organ responsible for the metabolic breakdown of alcohol in the human body is the:
(A) Liver
(B) Kidney
(C) Brain
(D) Lung

59. In the hepatic metabolism of ethanol, which enzyme is responsible for the first step, oxidizing ethanol to acetaldehyde?
(A) Aldehyde dehydrogenase (ALDH)
(B) Alcohol dehydrogenase (ADH)
(C) Cytochrome P450 2E1 (CYP2E1)
(D) Catalase

60. The widely accepted Widmark formula is used by forensic scientists to estimate:
(A) The total time elapsed since the last alcoholic beverage was consumed
(B) The total amount of alcohol consumed from blood alcohol concentration
(C) The dynamic rate of alcohol absorption from the gastrointestinal tract
(D) The physiological partition ratio between breath and blood alcohol

61. In the classical Widmark equation ($A = W \ \times r \times c$), the Widmark factor '$r$' represents:

the solvent front, serving as a baseline measure under standardized operational conditions.

36. (C) Gas Chromatography-Mass Spectrometry (GC-MS)
Gas chromatography-mass spectrometry is universally recognized as the gold standard for confirmatory drug analysis in forensic laboratories. Gas chromatography effectively separates complex mixtures into individual volatile components, while mass spectrometry fragments each compound to generate a highly specific, reproducible mass-to-charge spectrum. This unique spectral fingerprint allows definitive structural identification meeting rigorous legal evidentiary standards.

37. (A) Liquid Chromatography-Mass Spectrometry (LC-MS)
Liquid chromatography-mass spectrometry offers major operational advantages over gas chromatography when analyzing thermally labile, highly polar, or non-volatile drug metabolites. Unlike gas chromatography, which requires high temperatures and volatilization, liquid chromatography operates at ambient temperatures with liquid mobile phases. This eliminates the necessity for complex chemical derivatization while preserving thermal degradation-prone molecules in biological matrices.

38. (A) P-2, Q-4, R-1, S-3
Presumptive chemical reagents are matched to specific target drug categories based on characteristic chromogenic reactions:

Ehrlich's reagent contains p-dimethylaminobenzaldehyde, detecting indoles like LSD.

Mandelin reagent detects amphetamines and alkaloids like strychnine.

Dille-Koppanyi reagent selectively reacts with barbiturates.

Froehde reagent uses molybdic acid to presumptively identify general opioids.

39. (B) Helium
In gas chromatography, helium is the most widely utilized mobile phase carrier gas due to its high inertness, safety, and optimal chromatographic efficiency. Helium maintains low chemical reactivity with both column stationary phases and volatile analytes, efficiently sweeping vaporized sample molecules through capillary columns while optimizing peak resolution and detector response stability.

40. (C) Base peak
In electron ionization mass spectrometry, the spectrum represents ion abundance plotted against mass-to-charge ratio. The single ion peak displaying the highest absolute intensity is designated as the base peak and arbitrarily normalized to one hundred percent relative abundance. All other fragment and isotope ion peaks in the spectrum are scaled proportionally relative to this dominant peak.

41. (D) The functional groups and chemical bonds present in the molecule
Fourier transform infrared spectroscopy measures the absorption of infrared radiation by molecules, causing specific covalent bonds to undergo vibrational transitions such as stretching and bending. Because distinct chemical functional groups absorb characteristic frequencies within the infrared spectrum, the resulting absorption pattern provides detailed structural information regarding functional groups and overall molecular architecture.

42. (A) Hair allows for a much longer window of detection, often spanning months.
Hair analysis offers a uniquely extended temporal window for drug detection compared to transient fluids like blood or urine. As circulating drugs pass through hair follicle capillaries, they are incorporated into the growing keratinized matrix. Because human scalp hair grows continuously, segmental sectioning provides a permanent chronological record of past drug exposure over extended months.

43. (B) 1.0 to 1.3 centimetres per month
Human scalp hair grows at a relatively stable, predictable rate averaging approximately one to one-and-a-half centimeters per month, or roughly 0.35 millimeters daily. Forensic toxicologists utilize this established growth rate during segmental hair analysis to estimate historical drug exposure timelines, dividing hair shafts into centimeter sections representing approximate monthly exposure windows.

44. (B) Immunoassays (such as EMIT or ELISA)
Immunoassays, including enzyme-multiplied immunoassay technique and enzyme-linked immunosorbent assay, serve as the standard

Click Here to Buy book on Amazon

milliliters of alveolar air contain the same mass of ethanol as one milliliter of blood.

64. (B) I, II, and IV only
The Narcotic Drugs and Psychotropic Substances Act prohibits illegal cultivation of coca plants while granting regulatory frameworks for state-supervised cultivation of opium poppy for medical purposes. Section 27 outlines penal provisions for unauthorized consumption. The statute regulates, rather than completely bans, medical production of synthetic opioids under strict licensing controls.

65. (B) Potassium dichromate
Classic wet-chemical breathalyzer instruments utilize an acidic solution of potassium dichromate and sulfuric acid, with silver nitrate serving as a catalyst. When ethanol from breath passes through the chemical cell, orange dichromate ions undergo reduction to green chromic sulphate, oxidizing ethanol to acetic acid. The degree of color change quantifies alcohol concentration photometrically.

66. (D) Measuring volatile alcohol molecules in the equilibrium gas phase above the liquid blood sample in a sealed vial
Headspace gas chromatography operates on the thermodynamic equilibrium established between volatile compounds dissolved in a liquid sample and the vapor phase directly above it inside a sealed vial. Upon thermostating the vial, volatile ethanol evaporates into the headspace until equilibrium is attained, allowing direct sampling of the upper gas phase for chromatographic analysis.

67. (A) n-Propanol
n-Propanol is widely used as an internal standard in forensic headspace gas chromatography for blood alcohol quantification. As a primary alcohol absent from human biological specimens, n-propanol exhibits chemical properties, volatility, and chromatographic retention behavior similar to ethanol, compensating effectively for minor sample preparation variations, injection volume fluctuations, and instrument drift.

68. (C) Methanol
Illicit liquor fatalities in hooch tragedies are primarily caused by toxic contamination with methanol. Methanol is improperly introduced either through crude, unrefined distillation of wood derivatives or deliberate adulteration of denatured industrial spirits. Ingestion leads to severe systemic toxicity, profound metabolic acidosis, optic nerve destruction, permanent blindness, and high mortality rates among victims.

69. (A) Formaldehyde and formic acid
Methanol toxicity stems from its hepatic metabolic conversion by hepatic alcohol dehydrogenase into formaldehyde. Formaldehyde is rapidly oxidized by aldehyde dehydrogenase into formic acid or formate ions. Formate accumulation inhibits mitochondrial cytochrome c oxidase, causing cellular hypoxia, profound metabolic anion-gap acidosis, severe optic disc edema, and targeted tissue toxicity in the central nervous system.

70. (D) Permanent visual blindness from optic nerve damage
A clinical hallmark of severe methanol toxicity in surviving patients is permanent visual impairment or complete blindness. This ocular damage is directly caused by accumulated formic acid metabolites, which selectively inhibit oxidative phosphorylation within the optic nerve head and retinal ganglion cells. Progressive ocular hypoxia triggers axonal degeneration, optic atrophy, and irreversible loss of vision.

71. (B) Ethanol outcompetes methanol for alcohol dehydrogenase, preventing formation of toxic metabolites.
Intravenous ethanol serves as an antidote in acute methanol poisoning due to substrate competition. Alcohol dehydrogenase displays a significantly higher binding affinity for ethanol than for methanol—roughly ten to twenty times greater. Administering therapeutic ethanol saturates the enzyme, competitively inhibiting methanol oxidation and allowing unmetabolized methanol to be excreted harmlessly via kidneys and lungs.

72. (B) 30 mg of alcohol per 100 ml of blood
Section 185 of the Motor Vehicles Act in India establishes the statutory legal threshold limit for driving under the influence of alcohol. A person is legally considered intoxicated if breathalyzer testing or blood toxicological analysis reveals a blood alcohol concentration exceeding 30 milligrams of ethanol per 100 milliliters of blood during vehicle operation.

NODIA

54. (D) Carbon dioxide
Microbial fermentation of simple carbohydrates by yeast, such as Saccharomyces cerevisiae, occurs under anaerobic metabolic conditions. The yeast enzymes break down monosaccharides like glucose into ethyl alcohol and carbon dioxide gas as major end products. Carbon dioxide release is responsible for effervescence in fermented beverages like beer and sparkling wine during production.

55. (B) 14 to 16 %
During traditional natural fermentation, yeast cells convert plant sugars into ethanol. However, elevated ethanol concentrations disrupt lipid cell membranes and inhibit metabolic enzymes within the yeast. Once ethanol concentration reaches approximately fourteen to sixteen percent by volume, yeast toxicity occurs, halting further fermentation unless specialized ethanol-tolerant strains or distillation methods are used.

56. (C) Small intestine
Following oral ingestion, a small fraction of ethanol is absorbed through the stomach lining, but approximately eighty percent is rapidly absorbed in the upper small intestine, primarily the duodenum and jejunum. The massive surface area and rich vascularization of the intestinal mucosa enable rapid passive diffusion of alcohol into portal venous blood.

57. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Preliminary drug screening via immunoassay relies on antibody-antigen binding, which is susceptible to cross-reactivity with non-target compounds sharing similar structural moieties. This limitation can cause false-positive results from legal medications. Consequently, positive screening results require confirmatory analysis using highly specific, mass-selective instruments like GC-MS to isolate, identify, and quantify analytes conclusively.

58. (A) Liver
The liver is the principal organ responsible for clearance and metabolic elimination of absorbed ethyl alcohol, metabolizing over ninety percent of systemic ethanol. Hepatic tissue contains high concentrations of primary oxidative enzymes, specifically cytosolic alcohol dehydrogenase and microsomal P450 systems, which convert ethanol into metabolic intermediates prior to renal and pulmonary elimination.

59. (B) Alcohol dehydrogenase (ADH)
The initial, rate-limiting step in hepatic alcohol metabolism is catalyzed by the cytosolic zinc metalloenzyme alcohol dehydrogenase. This enzyme oxidizes ethanol into acetaldehyde by transferring hydrogen to the coenzyme nicotinamide adenine dinucleotide. Acetaldehyde, a toxic metabolic intermediate, is subsequently converted into acetic acid by mitochondrial aldehyde dehydrogenase enzymes.

60. (B) The total amount of alcohol consumed from blood alcohol concentration
The Widmark formula is a classical forensic pharmacokinetics equation used to estimate total alcohol absorbed into systemic circulation based on measured blood alcohol concentration. Incorporating variables such as body weight, biological sex distribution factors, and elimination rates, the equation allows forensic toxicologists to back-calculate total absorbed dose or historical concentration levels.

61. (A) The ratio of body water to total body weight
In the Widmark equation, the factor r represents the distribution ratio of alcohol in the whole body relative to blood concentration. Pharmacologically, this constant reflects total body water as a fraction of total body weight, since highly water-soluble ethanol distributes uniformly throughout aqueous body fluid compartments rather than adipose tissue.

62. (C) Females have a higher proportion of body fat and lower total body water content.
The Widmark distribution factor r averages approximately 0.68 for males and 0.55 for females. This physiological difference stems from average body composition variations, as females generally possess a higher percentage of adipose tissue and lower total body water content per kilogram. Consequently, ethanol distributes into a smaller aqueous volume in females.

63. (B) 2100 : 1
Breath alcohol analysis relies on Henry's Law governing gas-liquid equilibrium in pulmonary alveoli. At normal expired breath temperature of 34°C, the blood-to-breath partition ratio for ethanol is universally established in forensic standards as 2100:1. This ratio means 2100

Downloaded from www.pdf.tube

primary screening methods for routine urine drug testing. These techniques utilize antigen-antibody binding reactions to rapidly process large sample volumes at low cost. Positive immunoassay screening results are subsequently confirmed using highly specific chromatographic techniques like GC-MS.

45. (A) Creatinine
Creatinine is a endogenously produced metabolic breakdown product of muscle creatine phosphate that is excreted in urine at steady daily rates. Toxicologists routinely measure urinary creatinine concentrations to evaluate sample validity. Creatinine levels falling below physiological thresholds indicate sample dilution from excessive fluid consumption or specimen adulteration intended to bypass workplace drug testing.

46. (C) Sodium fluoride
Sodium fluoride is added to biological blood collection tubes in forensic toxicology as an enzyme inhibitor. It preserves sample integrity by inhibiting glycolytic and enzymatic pathways, preventing both in-vitro microbial degradation of drugs and neo-formation of ethanol by flora. It is frequently combined with potassium oxalate, an anticoagulant, to maintain specimen stability during storage.

47. (B) 4, 2, 1, 3
The standard analytical sequence for basic drug analysis in urine involves four logical steps:

First, enzymatically hydrolyze glucuronide conjugates to free bound drug metabolites.

Second, isolate target analytes via alkaline liquid-liquid extraction.

Third, derivatize polar groups to improve volatility.

Fourth, inject the prepared derivative into the gas chromatograph for separation.

48. (C) Small, Intermediate, and Commercial quantities
Under the Narcotic Drugs and Psychotropic Substances Act in India, offences and associated penalties are structured around three statutory weight-based quantity thresholds. Seizures are classified legally into small quantity, intermediate quantity, and commercial quantity. Penalties scale progressively, with commercial quantities carrying severe mandatory minimum prison terms and heavy monetary fines.

NODIA

49. (D) I, II, and III
Electron ionization is a high-energy, hard ionization technique causing extensive molecular ion fragmentation into reproducible structural ions. Chemical ionization represents a soft ionization method that preserves the protonated molecular ion. Consequently, electron ionization fragmentation patterns produce highly specific structural fingerprints essential for searching standard spectral libraries to identify unknown drugs.

50. (B) 5 grams
Under the statutory notifications issued under the Narcotic Drugs and Psychotropic Substances Act in India, specific weight thresholds define legal severity for diacetylmorphine. The small quantity threshold for heroin is established at five grams or less, whereas the commercial threshold starts at two hundred and fifty grams, determining bail provisions and sentencing scales.

51. (C) 1 kilogram
Under official notifications of the Narcotic Drugs and Psychotropic Substances Act in India, Charas, defined as separated cannabis resin, has designated weight thresholds. The small quantity limit is set at one hundred grams, while any quantity equal to or exceeding one kilogram is legally classified as a commercial quantity, attracting rigorous penal consequences.

52. (C) Narcotics Control Bureau (NCB)
The Narcotics Control Bureau, established in 1986 under the Ministry of Home Affairs, serves as India's premier nodal enforcement agency for drug law enforcement. It is mandated to enforce provisions of the NDPS Act, coordinate counter-trafficking efforts across state police departments, oversee intelligence operations, and fulfill international drug control treaty obligations.

53. (A) Ethanol
Ethanol, chemically known as ethyl alcohol, is a two-carbon aliphatic alcohol and the sole consumable psychoactive alcohol found in alcoholic beverages. Produced through microbial fermentation of natural sugars, ethanol acts primarily as a central nervous system depressant. Other low-molecular-weight alcohols, such as methanol or isopropanol, possess high toxicity and are unsuitable for human consumption.

73. (D) Denatured alcohol
Denatured alcohol refers to ethanol rendered unpalatable or toxic for human consumption through the deliberate addition of chemical denaturants, such as methanol, pyridine, or denatonium benzoate. This process allows industrial and solvent applications of ethanol to bypass beverage alcohol excise taxes without posing a risk of redirection for recreational consumption.

74. (A) Iodoform test
The iodoform test is a chemical test used to identify compounds containing methyl ketone or secondary alcohol structures adjacent to a methyl group, such as ethanol. Treating ethanol with aqueous iodine and sodium hydroxide yields triiodomethane, forming a distinctive yellow crystalline precipitate characterized by a sharp, medicinal odor indicative of a positive reaction.

75. (B) Alcohol is eliminated at a constant mass per hour, independent of blood concentration.
Zero-order elimination kinetics implies that a substance is metabolized at a constant rate per unit time, regardless of its circulating concentration in blood. Because hepatic alcohol dehydrogenase becomes fully saturated at low blood alcohol concentrations, ethanol clearance occurs at a fixed mass per hour rather than a constant percentage or proportional elimination fraction.

76. (B) Synthetic drug analogs modified chemically to evade legal controls
Designer drugs are synthetic chemical analogs designed to mimic the pharmacological actions of controlled substances while intentionally modifying chemical structures. Controlled molecular alterations allow illicit chemists to circumvent existing drug scheduling laws and regulatory frameworks while producing potent psychoactive substances that evade detection in conventional routine toxicological drug screening protocols.

77. (A) Lysergic acid diethylamide (LSD)
Lysergic acid diethylamide is a Schedule I hallucinogenic ergoline derivative characterized by extreme potency at microgram doses. Because required physical doses are minuscule, liquid LSD solution is commonly absorbed onto small squares of perforated absorbent paper known as blotter paper, which are ingested orally to produce profound sensory perceptual alterations and visual hallucinations.

78. (B) Ethanol → Acetaldehyde → Acetic acid → Carbon dioxide + Water
Hepatic metabolism of ethyl alcohol proceeds through a defined step-wise enzymatic clearance pathway in the liver:

Ethanol is initially oxidized by alcohol dehydrogenase into toxic intermediate acetaldehyde.

Acetaldehyde is rapidly converted by aldehyde dehydrogenase into non-toxic acetic acid.

Acetic acid subsequently enters general metabolic pathways, ultimately breaking down into carbon dioxide and water.

79. (A) P-3, Q-1, R-4, S-2
Forensic alcohol testing and toxicological screening rely on key scientific principles and chemical tests:

The Widmark formula estimates blood alcohol levels based on total quantity ingested.

Henry's law forms the physical basis for breath alcohol instruments.

The iodoform test chemically confirms ethanol presence.

The Duquenois-Levine color test provides presumptive identification of cannabis.

80. (C) External environmental exposure cannot cause false positive results in hair drug testing.
External environmental contamination poses a major analytical challenge in forensic hair testing for drugs of abuse. Passive exposure to airborne drug smoke, dust, or contaminated hands can cause drug incorporation into outer hair cuticle layers, mimicking active systemic ingestion. Laboratory decontamination washing procedures are required to prevent false positive results from external surface contamination.

81. (B) Oral fluid (Saliva)
Oral fluid is optimal for detecting recent drug ingestion occurring within a few hours. Because free, unbound drugs pass rapidly from capillary blood into salivary glands via passive diffusion, oral fluid concentrations correlate strongly with unbound blood drug levels, reflecting immediate physiological presence and acute intoxication far better than urine or hair matrices.

Click Here to Buy book on Flipkart

29. Select the correct order of initial steps to be followed when handling physical evidence (e.g., clothing) from an acid attack scene:
(A) Secure in paper bag → Dry the clothing in direct sunlight → Forward to lab → Cut the stained area.
(B) Photograph the stain in situ → Allow to air dry at room temperature without sunlight → Pack in a clean, dry glass or plastic container → Seal and forward with chain of custody.
(C) Wash the stain with water to dilute the acid → Pack in a polythene bag → Forward to lab → Photograph.
(D) Apply neutralizing base directly to the stain → Air dry → Pack in a cloth parcel → Forward to lab.

30. During the chemical examination of charred clothing from a suspected corrosive attack case, a water extract of the stain yields a dense white precipitate upon the addition of barium chloride ($BaCl_2$) solution. The precipitate is insoluble in dilute HCl. This indicates the presence of:
(A) Hydrochloric acid
(B) Nitric acid
(C) Sulphuric acid
(D) Acetic acid

31. Which of the following mineral acids is commonly known as "Oil of Vitriol"?
(A) Hydrochloric acid
(B) Nitric acid
(C) Phosphoric acid
(D) Sulphuric acid

32. Aqua regia, a highly corrosive mixture capable of dissolving noble metals like gold and platinum, is prepared by mixing concentrated hydrochloric acid and concentrated nitric acid in a volumetric ratio of:
(A) 1:3
(B) 3:1
(C) 1:1
(D) 2:1

33. Consider the following statements regarding corrosive burns:
I. Sulphuric acid produces brown or black charred eschars due to its strong dehydrating action.
II. Nitric acid burns characteristically produce a yellow discoloration on the skin due to the xanthoproteic reaction.
III. Hydrochloric acid produces deep liquefactive necrosis similar to strong alkalis.
Which of the above statement(s) is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

34. Consider the following assertion and reason:
Assertion (A): Ingested strong alkalis (like sodium hydroxide) generally cause more severe damage to the oesophagus than ingested strong acids.
Reason (R): Strong alkalis cause liquefactive necrosis, which allows deep tissue penetration, whereas strong acids cause coagulative necrosis, which forms a protective eschar limiting deeper penetration.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

35. Under legal provisions regarding grievous hurt caused by acid, what defines the substance used in an "acid attack"?
(A) Any acidic or corrosive substance capable of causing bodily injury or disfigurement.
(B) Any liquid substance exhibiting a measured pH value strictly below 2.0 under standard conditions.
(C) Only inorganic mineral acids that are explicitly named in statutory chemical schedules.
(D) Only chemical substances that are exclusively derived through industrial organic synthesis methods.

NODIA

36. Which of the following is an organic acid frequently associated with chemical burns and historically used in explosives (like Lyddite)?
(A) Formic acid
(B) Citric acid
(C) Picric acid
(D) Ascorbic acid

37. Which of the following best describes the chemical nature of a normal salt?
(A) Salt formed by complete replacement of acid hydrogen atoms by a metal or ammonium ion.
(B) A salt formed by the partial replacement of

CHAPTER 19

Acids, Bases and Salts

NODIA

1. Matter is primarily classified into pure substances and mixtures. Which of the following is an example of a pure chemical compound rather than a mixture?
(A) Brass
(B) Distilled water
(C) Air
(D) Blood

2. The chemical bond formed by the complete transfer of one or more electrons from one atom to another is known as:
(A) Covalent bond
(B) Coordinate covalent bond
(C) Hydrogen bond
(D) Ionic bond

3. In atomic structure, isotopes of an element have the same number of protons but differ in the number of:
(A) Neutrons
(B) Electrons
(C) Positrons
(D) Alpha particles

4. Which of the following statements about elements, compounds, and mixtures is incorrect?
(A) A compound has a fixed composition by mass.
(B) The constituents of a mixture can usually be separated by physical methods.
(C) The properties of a compound are an average of the properties of its constituent elements.
(D) An element consists of only one type of atom.

5. Calculate the molarity of a solution containing 4.0 grams of sodium hydroxide (NaOH) dissolved in enough water to make 250 mL of solution. (Molar mass of NaOH = 40 g/mol)
(A) 0.1 M
(B) 0.2 M
(C) 0.4 M
(D) 1.0 M

6. Consider the following statements regarding concentration terms:
I. Molarity is defined as the number of moles of solute per kilogram of solvent.
II. Molality is independent of temperature changes.
III. Normality depends on the equivalent weight of the solute.
Which of the above statement(s) is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

7. A 1 Molar (1 M) solution of sulphuric acid (H_2SO_4) has a normality of:
(A) 0.5 N
(B) 1.0 N
(C) 2.0 N
(D) 3.0 N

8. Match the acid-base concepts in List I with their corresponding definitions in List II.
List I: Acid-Base Concept
P. Arrhenius acid
Q. Bronsted-Lowry base
R. Lewis acid
S. Lewis base
List II: Definition
1. Electron pair acceptor
2. Proton (H^+) acceptor
3. Electron pair donor
4. Produces H^+ ions in aqueous solution
(A) P-4, Q-1, R-2, S-3
(B) P-2, Q-4, R-3, S-1
(C) P-4, Q-2, R-1, S-3
(D) P-1, Q-2, R-4, S-3

9. According to the Lewis concept of acids and bases, which of the following acts as a Lewis acid?
(A) Ammonia (NH_3)
(B) Water (H_2O)
(C) Chloride ion (Cl^-)
(D) Boron trifluoride (BF_3)

10. Consider the following assertion and reason:
Assertion (A): The conjugate base of a strong

82. (D) When tolerance to one drug reduces physiological response to another drug in the same class

Cross-tolerance is a pharmacological phenomenon occurring when neuroadaptation acquired from repeated exposure to one drug decreases physiological or behavioral sensitivity to another substance. This commonly occurs among drugs belonging to identical pharmacological classes or sharing common neurochemical receptor targets, such as mutual cross-tolerance between various central nervous system depressants or opioid receptor agonists.

83. (B) 40%

In the United States proof system for alcohol measurement, proof is defined as exactly twice the percentage of alcohol by volume at 60°F. Therefore, an alcoholic beverage labeled as 80 proof contains forty percent ethanol by volume, whereas 100 proof represents fifty percent ethanol concentration, simplifying conversion between proof and volume metrics.

84. (C) Flunitrazepam

Flunitrazepam, commercially known as Rohypnol, is a potent benzodiazepine derivative with strong sedative, muscle-relaxant, and amnestic properties. Frequently referred to colloquially as Roofies, it is implicated in drug-facilitated sexual assault due to its fast onset and ability to induce profound sedation and anterograde amnesia, particularly when dissolved undetected in alcoholic beverages.

85. (D) I, II, and III

Methanol toxicity is mediated by its metabolic breakdown rather than intrinsic parent toxicity. Hepatic conversion produces formic acid, which inhibits mitochondrial respiration and causes profound metabolic acidosis. Fomepizole acts as a potent competitive inhibitor of alcohol dehydrogenase, blocking methanol oxidation and preventing toxic acid accumulation during clinical emergency treatment.

86. (A) I, II, and III only

New psychoactive substances are modified chemically to bypass legal controls. Synthetic cathinones in bath salts produce stimulant effects, while synthetic cannabinoids act as potent full agonists at cannabinoid receptors. Standard commercial immunoassay screening tests typically fail to detect modern variations, requiring advanced chromatographic techniques like LC-MS for reliable toxicological identification.

87. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.

Headspace gas chromatography requires precise temperature regulation of sample vials prior to gas sampling. According to Henry's Law, the partition coefficient governing ethanol distribution between liquid blood and gaseous headspace is highly temperature-dependent. Maintaining a constant, elevated temperature ensures stable phase equilibrium, yielding accurate, reproducible quantitative blood alcohol concentration measurements.

88. (A) I and II only

Basic drugs bind selectively to melanin pigments in human hair, resulting in higher accumulation in darker hair compared to light hair. Hair testing provides a durable historical record, making it valuable in delayed sexual assault investigations. However, single low-dose drug exposures often fail to yield detectable concentrations in hair keratin matrices.

89. (A) P-3, Q-1, R-2, S-4

Under the Narcotic Drugs and Psychotropic Substances Act, commercial quantity thresholds define legal severity:

Commercial threshold for diacetylmorphine is set at 250 grams.

Commercial threshold for cocaine base is established at 100 grams.

Commercial quantity for Ganja is defined at 20 kilograms.

Commercial threshold for MDMA is set at 10 grams.

90. (C) 2, 1, 4, 3

Processing physical drug evidence at crime scenes follows strict forensic protocol steps:

First, document and photograph the evidence in situ.

Second, conduct a preliminary presumptive spot test on a minute sample.

Third, securely package, seal, and sign the powder exhibit to preserve chain of custody.

Fourth, transmit the sealed exhibit to the laboratory.

Downloaded from www.pdf.tube

(B) The concentration of the salt component is ten times higher than the acid concentration.
(C) The weak acid concentration equals its conjugate base concentration.
(D) The total volume of the buffer solution in the system becomes extremely large.

21. Using the Henderson-Hasselbalch equation, what is the expected pH of a buffer solution containing 0.1 M acetic acid (pKa = 4.76) and 0.1 M sodium acetate?
(A) 3.76
(B) 4.76
(C) 5.76
(D) 7.00

22. Consider the following statements regarding biological buffers:
I. The bicarbonate buffer system is the primary extracellular buffer in human blood.
II. Phosphate buffers play a major role in intracellular buffering.
III. Proteins, particularly haemoglobin, do not contribute to the buffering capacity of blood.
Which of the above statement(s) is/are correct?
(A) I and III only
(B) II and III only
(C) I and II only
(D) I, II and III

23. An acidic buffer can be prepared by mixing equimolar amounts of:
(A) A strong acid and its salt with a strong base
(B) A weak acid and its salt with a strong base
(C) A weak base and its salt with a strong acid
(D) A strong base and its salt with a weak acid

24. Which of the following statements most accurately defines the equivalence point in an acid-base titration?
(A) The precise point in the titrimetric procedure at which the visual indicator changes its colour.
(B) The specific stage during titration at which the pH value of the reaction solution becomes exactly 7.0.
(C) The point at which equivalents of acid exactly equal equivalents of base.
(D) The stage where the total volume of titrant added is precisely equal to the initial volume of analyte solution.

25. In the titration of a strong acid (like HCl) with a strong base (like NaOH), the rapid change in the titration curve occurs in the pH range of approximately:
(A) 2 to 6
(B) 4 to 10
(C) 8 to 12
(D) 6 to 8

26. Consider the following assertion and reason:
Assertion (A): Phenolphthalein is a suitable indicator for the titration of a strong acid with a strong base.
Reason (R): The pH jump near the equivalence point in a strong acid-strong base titration encompasses the pH range (8.2 - 10.0) where phenolphthalein changes colour.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

27. When conducting an acid-base titration, a curve plotted between pH and volume of titrant shows the equivalence point as the:
(A) Region representing the maximum buffering capacity of the titration solution.
(B) Point of inflection with the steepest slope.
(C) Extended region where the titration curve becomes completely horizontal.
(D) Precise region representing the minimum electrical conductance of the solution.

28. Consider the following statements regarding the selection of indicators for different types of titrations:
I. Methyl orange is suitable for strong acid-weak base titrations.
II. Phenolphthalein is suitable for weak acid-strong base titrations.
III. No simple indicator is suitable for weak acid-weak base titrations because the pH jump at the equivalence point is too small.
IV. Universal indicator is preferred for precise analytical volumetric titrations over single-component indicators.
Which of the above statement(s) is/are incorrect?
(A) I only
(B) IV only
(C) II and III only
(D) I, II and III

NODIA

acid is a weak base.
Reason (R): A strong acid readily donates its proton, meaning the resulting conjugate base has a low affinity for protons.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

11. What is the conjugate base of the bisulphate ion (HSO_4^-)?
(A) H_2SO_4
(B) SO_4^{2-}
(C) $H_3SO_4^+$
(D) SO_3^{2-}

12. Which of the following represents the correct mathematical expression for the pH of an aqueous solution?
(A) pH = log[H^+]
(B) pH = -log[H^+]
(C) pH = -ln[H^+]
(D) pH = 1/log[H^+]

13. Consider the following statements regarding strong and weak acids:
I. Strong acids undergo complete ionisation in dilute aqueous solutions.
II. Weak acids have a low value of acid dissociation constant (Ka).
III. The higher the pKa value of an acid, the stronger the acid.
IV. Acetic acid is an example of a weak organic acid.
Which of the above statement(s) is/are correct?
(A) I, II and IV
(B) I, II and III
(C) II, III and IV
(D) I, III and IV

14. Among the following, which is considered a weak base?
(A) Sodium hydroxide
(B) Potassium hydroxide
(C) Ammonium hydroxide
(D) Barium hydroxide

15. If the hydroxyl ion concentration [OH^-] of an aqueous sample is 1.0×10^{-4} M at 25°C, what is the pH of the sample?
(A) 4
(B) 10
(C) 14
(D) 7

16. Match the pH indicators in List I with their characteristic colour in an alkaline (basic) medium in List II.
List I: Indicator
P. Phenolphthalein
Q. Methyl orange
R. Litmus
S. Bromothymol blue
List II: Colour in Basic Medium
1. Yellow
2. Blue
3. Pink/Red
4. Blue
(A) P-1, Q-3, R-2, S-4
(B) P-3, Q-1, R-4, S-2
(C) P-3, Q-2, R-1, S-4
(D) P-2, Q-4, R-3, S-1

17. The glass electrode used in a pH meter measures the potential difference across a thin glass membrane. This potential is dependent on the concentration of which specific ion?
(A) Sodium ion
(B) Hydrogen ion
(C) Chloride ion
(D) Potassium ion

18. Arrange the following aqueous solutions in the correct order of increasing pH at 25°C:
I. 0.1 M Hydrochloric acid
II. Pure water
III. 0.1 M Sodium hydroxide
IV. Human blood
(A) I, II, IV, III
(B) I, IV, II, III
(C) III, IV, II, I
(D) II, I, IV, III

19. Which of the following is NOT used as a standard reference electrode in potentiometric pH measurements?
(A) Platinum-Iridium electrode
(B) Saturated calomel reference electrode
(C) Silver/silver chloride reference electrode
(D) Standard hydrogen reference electrode

20. The ability of a buffer solution to resist changes in its pH upon the addition of small amounts of strong acid or base is maximum when:
(A) The pH value of the aqueous solution is maintained at exactly 7.0 at all times.

Click Here to Buy book on Amazon

replaceable hydrogen atoms of a polybasic acid by a metallic cation.
(C) A salt containing replaceable hydroxyl (OH^-) groups formed by partial neutralization of a polyacidic base.
(D) A salt formed by mixing two simple salts in equimolar proportions, which subsequently crystallize together as a single compound.

38. Match the type of salt in List I with its correct example in List II.
List I: Salt Type
P. Acidic salt
Q. Basic salt
R. Double salt
S. Complex salt
List II: Example
1. Potassium ferrocyanide $[K_4Fe(CN)_6]$
2. Mohr's salt $[FeSO_4.(NH_4)^2SO_4.6H_2O]$
3. Sodium bicarbonate $(NaHCO_3)$
4. Basic copper carbonate $[CuCO_3.Cu(OH)_2]$
(A) P-3, Q-4, R-1, S-2
(B) P-4, Q-3, R-2, S-1
(C) P-2, Q-3, R-4, S-1
(D) P-3, Q-4, R-2, S-1

39. An aqueous solution of sodium carbonate (Na_2CO_3) will be:
(A) Neutral, because it is a salt of a strong acid and a strong base.
(B) Basic, because of the hydrolysis of the carbonate ion.
(C) Acidic, because of the hydrolysis of the sodium ion.
(D) Neutral, because it is a normal salt without replaceable hydrogen.

40. When a salt of a strong acid and a strong base (such as NaCl) is dissolved in pure water, it undergoes:
(A) Cationic hydrolysis
(B) Anionic hydrolysis
(C) Almost no hydrolysis
(D) Both cationic and anionic hydrolysis

41. Consider the following statements regarding the solubility product (Ksp) and precipitation:
I. Ksp is applicable only to sparingly soluble salts.
II. Precipitation occurs only when the ionic product exceeds the solubility product.
III. The common ion effect increases the solubility of a sparingly soluble salt.
IV. Ksp is dependent on temperature.
Which of the above statement(s) is/are incorrect?
(A) I and II only
(B) III only
(C) II and IV only
(D) I, III and IV

42. The principle of the common ion effect is widely used in qualitative inorganic analysis. It is defined as the suppression of the degree of ionisation of a:
(A) Weak electrolyte by the addition of a strong electrolyte containing a common ion.
(B) Strong electrolyte by the addition of a weak electrolyte containing a common ion.
(C) Non-electrolyte by the addition of a strong electrolyte.
(D) Strong acid by the addition of a strong base.

NODIA

43. Consider the following assertion and reason:
Assertion (A): In the qualitative analysis of basic radicals, Group II cations are precipitated as sulphides by passing H_2S gas in the presence of dilute HCl.
Reason (R): Dilute HCl suppresses the ionisation of H_2S due to the common ion effect, ensuring only Group II sulphides (which have very low Ksp) precipitate.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

44. The solubility of silver chloride (AgCl) in a 0.1 M NaCl solution compared to its solubility in pure water will be:
(A) Higher
(B) Lower
(C) Exactly the same
(D) Zero

45. Arrange the following group reagents in the correct sequence as they are used sequentially in the qualitative analysis of basic radicals (from Group I to Group IV):
I. H_2S gas in the presence of NH_4OH
II. Dilute HCl
III. NH_4OH in the presence of NH_4Cl
IV. H_2S gas in the presence of dilute HCl
(A) II, IV, III, I
(B) II, I, III, IV
(C) IV, II, III, I
(D) III, IV, II, I

the drug.
(C) Maintained exactly at pH 7.
(D) Adjusted to pH 14 using strong alkali.

68. The valency of an element in a compound is fundamentally determined by the number of electrons in its:
(A) Innermost electronic shell
(B) Atomic nucleus region
(C) Valence shell
(D) Entire atomic structure

69. A solution is formed by dissolving a substance in water. The solution conducts electricity, turns red litmus paper blue, and feels slippery to the touch. The dissolved substance is best classified as a:
(A) Base
(B) Strong acid
(C) Covalent salt
(D) Non-polar solvent

70. According to the Arrhenius concept, an acid is fundamentally limited to a substance that:
(A) Accepts an electron pair from a donor species in any solvent medium.
(B) Donates a proton exclusively when dissolved in non-aqueous solvents.
(C) Neutralises alkalis through direct formation of a complex coordination salt.
(D) Produces H^+ ions in aqueous solution.

71. The relationship between the acid dissociation constant (Ka) of a weak acid and the base dissociation constant (Kb) of its conjugate base in aqueous solution is given by:
(A) Ka + Kb = Kw
(B) Ka × Kb = Kw
(C) Ka / Kb = Kw
(D) Ka - Kb = Kw

72. Which of the following is a limitation of the Arrhenius concept of acids and bases?
(A) It easily explains the basic nature and alkalinity of sodium hydroxide in water.
(B) It effectively predicts the measured pH values of strong inorganic mineral acids.
(C) It fails to explain acid-base behavior in non-aqueous solvents.
(D) It fully explains why hydrogen chloride exists as a gas under standard conditions.

73. Which of the following statements about the pOH of a solution is correct?
(A) As the basicity of a solution increases, its pOH increases.
(B) pOH is calculated as the negative logarithm of the hydrogen ion concentration.
(C) A solution with a pOH of 2 is highly acidic.
(D) pOH + pH = 14 at 25°C.

74. In a laboratory pH meter calibration, two standard buffer solutions are normally used. For calibrating over the acidic range, typical buffers chosen have pH values of:
(A) 4.0 and 7.0
(B) 7.0 and 10.0
(C) 1.0 and 14.0
(D) 8.0 and 12.0

75. The salt bridge used in electrochemical cells (including pH measuring setups) primarily serves to:
(A) Provide a continuous flow of valence electrons directly to the cathode electrode.
(B) Maintain electrical neutrality by allowing ion migration.
(C) Connect the external electrical circuit mechanically without chemical participation.
(D) Prevent any movement or migration of ions between the two half-cell solutions.

76. In human blood, the ratio of bicarbonate ion (HCO_3^-) to carbonic acid (H_2CO^3) at a normal physiological pH of 7.4 (where pKa of carbonic acid is approx. 6.1) is roughly:
(A) 1:1
(B) 10:1
(C) 20:1
(D) 1:20

77. Which equation accurately represents a neutralisation reaction?
(A) Acid + Base → Salt + Water
(B) Acid + Metal → Salt + Hydrogen gas
(C) Base + Non-metal oxide → Salt + Water
(D) Metal carbonate + Acid → Salt + Water + Carbon dioxide

78. When titrating a weak base (like ammonia) against a strong acid (like hydrochloric acid), the pH at the equivalence point will be:
(A) Exactly 7.0
(B) Greater than 7.0
(C) Less than 7.0
(D) Indeterminable

79. The diphenylamine test is a common chemical spot test used to detect residues of explosives

Downloaded from www.pdf.tube

(D) Yellow

57. Which of the following is NOT typically used as an indicator in redox titrations?
(A) Diphenylamine indicator
(B) Ferroin redox indicator
(C) Soluble starch indicator
(D) Phenolphthalein

58. In complexometric titrations, substances that form very stable complexes with interfering metal ions, thus preventing them from reacting with the primary titrant (EDTA), are called:
(A) Masking agents
(B) Chelating agents
(C) Precipitating agents
(D) Primary standards

59. Identify the odd one out among the following items of laboratory glassware, based on their primary function in volumetric analysis:
(A) Burette
(B) Watch glass
(C) Pipette
(D) Volumetric flask

60. As a strict laboratory safety protocol, what is the correct and safest procedure for diluting concentrated sulphuric acid?
(A) Rapidly pour the concentrated acid directly into the water while stirring vigorously.
(B) Slowly add acid to water with continuous stirring.
(C) Slowly add liquid water dropwise directly into the beaker containing concentrated acid.
(D) Mix equal volumes of concentrated acid and water simultaneously inside a closed container.

61. If an accidental splash of a strong mineral acid occurs on the skin of a laboratory assistant, what is the most appropriate immediate first-aid measure before medical help arrives?
(A) Flush the affected skin with running water for 15 minutes.
(B) Apply a concentrated alkali solution such as sodium hydroxide directly to neutralize the acid.
(C) Apply an occlusive chemical burn ointment or topical cream immediately to seal the wound.
(D) Wipe the acid off gently with a dry towel and observe the skin to see if a burn develops.

62. In a laboratory, concentrated strong alkalis such as sodium hydroxide (NaOH) or potassium hydroxide (KOH) should NEVER be stored in glass bottles with glass stoppers because:
(A) Ambient light passing through standard transparent glass rapidly decomposes strong alkalis.
(B) Alkalis spontaneously combust upon prolonged direct physical contact with borosilicate glassware.
(C) Alkalis react with glass to form silicates, fusing the stopper.
(D) Borosilicate glass acts as an active physical catalyst for the rapid vaporization of alkalis.

63. If a small spill of concentrated hydrochloric acid occurs on a laboratory bench, the standard safety protocol for neutralization prior to cleanup is to apply:
(A) Concentrated sodium hydroxide pellets
(B) Pure acetone liquid solvent
(C) Boiling distilled water
(D) Solid sodium bicarbonate

NODIA

64. What mass of sodium chloride (NaCl) is required to prepare 1 litre of a 1 Molar standard solution? (Atomic masses: Na = 23, Cl = 35.5)
(A) 23.0 g
(B) 35.5 g
(C) 58.5 g
(D) 100.0 g

65. The ionic product of water (Kw) at standard laboratory temperature (25°C) is approximately:
(A) 1.0×10^{-7}
(B) 1.0×10^{-14}
(C) 1.0×10^{7}
(D) 1.0×10^{14}

66. The process by which two water molecules react to form a hydronium ion (H_3O^+) and a hydroxide ion (OH^-) is known as:
(A) Chemical electrolysis process
(B) Salt hydrolysis reaction
(C) Acid-base neutralisation
(D) Autoprotolysis

67. A drug that is a weak acid (like salicylic acid) will be most efficiently extracted from an aqueous biological sample into an organic solvent when the pH of the aqueous sample is:
(A) Adjusted to be much lower than the pKa of the drug.
(B) Adjusted to be much higher than the pKa of

electrons. This electron-deficient structure enables boron trifluoride to readily accept a lone pair of electrons from electron-rich species. Ammonia, water, and chloride ions act as Lewis bases because they possess available non-bonding lone pairs capable of donation.

10. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
In Bronsted-Lowry acid-base chemistry, a strong acid dissociates almost completely in aqueous solution because it possesses a strong tendency to release its proton. Consequently, its corresponding conjugate base exhibits an extremely weak affinity for accepting protons back. Therefore, the conjugate base of a strong acid acts as a weak base, making both statements true with the reason explaining the assertion.

11. (B) SO_4^{2-}
A conjugate base is formed when an acid removes or donates a single hydrogen proton. When the bisulphate anion donates one proton, it loses a positive hydrogen charge and leaves behind the sulphate divalent anion. Sulphuric acid represents the conjugate acid of bisulphate, whereas sulphate represents the conjugate base formed after proton donation in acid-base equilibria.

12. (B) $pH = -\log[H^+]$
The pH scale quantitatively measures hydrogen ion activity in aqueous solutions. Mathematically, pH is defined as the negative logarithm to base ten of the hydrogen or hydronium ion molar concentration. As hydrogen ion concentration increases, pH value decreases exponentially. Expressions using natural logarithms or positive logarithms without negative signs do not represent standard logarithmic pH scale conventions in chemical thermodynamics.

13. (A) I, II and IV
Strong acids ionise completely in dilute aqueous solutions, whereas weak acids undergo incomplete ionisation characterized by low acid dissociation constants. Acetic acid is a classic weak organic acid. Because pKa equals negative logarithm of Ka, higher pKa values indicate weaker acids, making statement three false. Statements one, two, and four correctly describe the fundamental properties of acids.

14. (C) Ammonium hydroxide
Ammonium hydroxide is classified as a weak base because it undergoes incomplete dissociation in aqueous solutions, producing low concentrations of hydroxyl ions in chemical equilibrium. Alkali metal hydroxides like sodium hydroxide and potassium hydroxide, along with alkaline earth metal hydroxides like barium hydroxide, ionise almost completely in water and are recognized as strong chemical bases.

15. (B) 10
The pOH of a solution equals the negative logarithm of hydroxyl ion concentration. Taking the negative logarithm of ten to the power of minus four gives a pOH value of four. At standard room temperature of twenty-five degrees Celsius, the sum of pH and pOH equals fourteen. Subtracting four from fourteen yields a resulting sample pH of ten.

16. (B) P-3, Q-1, R-4, S-2
Chemical indicators alter their colors depending on solution acidity or alkalinity. Phenolphthalein turns pink or red in basic media. Methyl orange displays a yellow color in alkaline solutions. Litmus paper or solution turns blue in basic conditions. Bromothymol blue also turns blue in alkaline environments above pH seven point six. Matching these specific characteristics verifies the correct indicator sequence.

17. (B) Hydrogen ion
The glass electrode used in pH meters contains a thin, specially formulated ion-exchange glass membrane sensitive to hydrogen ions. When immersed in aqueous solutions, a potential difference develops across the membrane due to exchange between alkali ions in the glass matrix and hydrogen ions in the solution, allowing precise quantitative measurement of hydrogen ion activity.

18. (A) I, II, IV, III
Hydrochloric acid is a strong acid possessing a low pH near one. Pure water is neutral with a pH of seven. Human blood is slightly alkaline, maintained physiologically between pH seven point three five and seven point four five. Sodium hydroxide is a strong base exhibiting a high pH near thirteen. Therefore, increasing pH order ranges from acid to neutral, blood, and alkali.

Click Here to Buy book on Flipkart

(like smokeless powders). This test detects the presence of:
(A) Inorganic chloride ions
(B) Inorganic sulphate ions
(C) Inorganic phosphate ions
(D) Nitrate and nitrite ions

80. Ammonia (NH_3) acts as a base when dissolved in water because it:
(A) Releases OH^- ions directly from its molecule.
(B) Donates an electron pair to the oxygen atom in water.
(C) Accepts a proton from water, generating OH^- ions.
(D) Forms a covalent bond with chloride ions.

81. In autopsy cases, a stomach exhibiting extensive, uniform charring (blackening) without significant liquefaction is most indicative of ingestion of:
(A) Strong aqueous alkali (e.g., Lye solution)
(B) Concentrated sulphuric acid
(C) Carbolic acid (Phenol compound)
(D) Solid inorganic arsenic trioxide

82. Corrosive action by strong mineral acids on living tissue is fundamentally characterised by:
(A) Saponification of fats and liquefaction of proteins.
(B) Direct binding to haemoglobin preventing oxygen transport.
(C) Inhibition of acetylcholinesterase at nerve junctions.
(D) Extraction of water and coagulation of tissue proteins.

83. The chemical formula for washing soda, a common basic salt used in household and industrial applications, is:
(A) $Na_2CO_3.10H_2O$
(B) $NaHCO_3$
(C) $NaOH$
(D) Na_2SO_4

84. Which of the following best distinguishes a double salt from a complex salt?
(A) A complex salt is characterized by containing only one single type of cation in its chemical structure.
(B) Double salts are usually organic compounds, whereas complex salts are strictly inorganic compounds.
(C) Double salts dissociate completely into simple ions in water, while complex ions remain intact.
(D) Double salts cannot crystallize from aqueous solutions under standard laboratory conditions.

85. The silver nitrate ($AgNO_3$) test for halogens in an acidified solution produces a pale yellow precipitate that is sparingly soluble in ammonium hydroxide. This observation specifically indicates the presence of:
(A) Bromide
(B) Chloride
(C) Iodide
(D) Fluoride

86. Flame photometry is often used in chemical analysis. In a standard flame test, which basic radical imparts a characteristic "apple green" colour to the non-luminous flame?
(A) Sodium (Na^+)
(B) Potassium (K^+)
(C) Strontium (Sr^{2+})
(D) Barium (Ba^{2+})

87. In the inorganic qualitative group separation scheme, why is ammonium chloride (NH_4Cl) added before ammonium hydroxide (NH_4OH) for the precipitation of Group III cations?
(A) To significantly increase the overall concentration of free hydroxyl (OH^-) ions in the reaction mixture.
(B) To suppress NH_4OH ionisation via common ion effect, preventing Group IV/V precipitation.
(C) To act as the primary direct precipitating agent for converting iron cations into hydroxides.
(D) To rapidly oxidise all ferrous ions (Fe^{2+}) into ferric ions (Fe^{3+}) prior to hydroxide addition.

88. A common source of error in gravimetric analysis is coprecipitation. This refers to:
(A) The intentional addition of a secondary precipitating reagent to complete the chemical reaction.
(B) The delayed precipitation occurring after the initial filtration process has been completed.
(C) Entrapment of normally soluble impurities during the formation of a precipitate.
(D) The thermal conversion of the precipitate into a different chemical composition during ignition.

Downloaded from www.pdf.tube

46. Match the analytical group of basic radicals in List I with the corresponding cations in List II.
List I: Analytical Group
P. Group I
Q. Group II
R. Group III
S. Group IV
List II: Cation
1. Fe^{3+}, Al^{3+}, Cr^{3+}
2. Ag^{+}, Pb^{2+}, Hg_2^{2+}
3. Zn^{2+}, Mn^{2+}, CO_2^{+}, Ni^{2+}
4. Cu^{2+}, Cd^{2+}, Pb^{2+}, Bi^{3+}
(A) P-1, Q-2, R-3, S-4
(B) P-4, Q-3, R-2, S-1
(C) P-2, Q-4, R-1, S-3
(D) P-2, Q-1, R-4, S-3

47. Which of the following is NOT a cation of Analytical Group I?
(A) Silver (Ag^{+})
(B) Lead (Pb^{2+})
(C) Mercurous (Hg_2^{2+})
(D) Barium (Ba^{2+})

48. In the qualitative analysis of acid radicals, the "Brown Ring Test" is a specific confirmatory test for which of the following anions?
(A) Chloride (Cl^{-})
(B) Sulphate (SO_4^{2-})
(C) Nitrate (NO_3^{-})
(D) Carbonate (CO_3^{2-})

49. The chromyl chloride test is used in qualitative chemical analysis to confirm the presence of which anion in a sample?
(A) Bromide
(B) Chloride
(C) Iodide
(D) Fluoride

50. Consider the following statements about qualitative testing for acid radicals:
I. Carbonates react with dilute mineral acids to effervesce, releasing CO_2.
II. Sulphates yield a white precipitate with barium chloride, which dissolves completely in concentrated HCl.
III. Acetate ions emit a vinegar-like odour when heated with concentrated sulphuric acid.
Which of the above statement(s) is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

51. Gravimetric analysis relies on determining the mass of a pure compound to which the analyte is chemically related. The key principle is based on the law of:
(A) Definite proportions
(B) Multiple proportions
(C) Conservation of energy
(D) Partial pressures

52. Which of the following volumetric techniques is based on the measurement of a complex forming reaction between the analyte and a titrant, commonly using EDTA?
(A) Volumetric acid-base titration
(B) Chemical precipitation titration
(C) Complexometric titration
(D) Oxidation-reduction titration

53. Select the correct order of the fundamental steps involved in a standard gravimetric analysis procedure:
(A) Precipitation → Filtration → Digestion → Washing → Drying/Ignition → Weighing
(B) Precipitation → Digestion → Filtration → Washing → Drying/Ignition → Weighing
(C) Filtration → Digestion → Precipitation → Washing → Weighing → Drying/Ignition
(D) Digestion → Washing → Precipitation → Filtration → Drying/Ignition → Weighing

NODIA

54. A substance used as a primary standard in volumetric analysis must possess all of the following characteristics EXCEPT:
(A) High purity
(B) Stability in air
(C) High solubility in the titration medium
(D) Low molecular weight

55. In complexometric titrations used to determine water hardness or specific metal ions in analytical samples, which of the following is a widely used metallochromic indicator?
(A) Potassium permanganate solution
(B) Eriochrome Black T
(C) Soluble starch indicator
(D) Ferroin indicator complex

56. When potassium permanganate ($KMnO_4$) is used as a titrant in redox titrations, it is an example of an auto-indicator. In a strongly acidic medium, its purple colour turns:
(A) Dark brown
(B) Green
(C) Colourless

ANSWERS

1. (B) Distilled water
Distilled water consists of pure hydrogen and oxygen chemically combined in a fixed ratio, representing a single chemical compound. In contrast, mixtures like brass, air, and blood contain multiple combined substances retaining individual properties. Pure compounds exhibit uniform chemical compositions throughout, unlike heterogeneous or homogeneous physical mixtures that can be separated into components using physical methods.

2. (D) Ionic bond
An ionic bond is formed through the complete electrovalent transfer of valence electrons from a electropositive metal atom to an electronegative non-metal atom. This process creates oppositely charged cations and anions held together by strong electrostatic forces. Covalent and coordinate bonds involve electron sharing, whereas hydrogen bonding involves intermolecular dipolar interactions rather than complete charge transfers.

3. (A) Neutrons
Isotopes are variants of a specific chemical element that possess identical atomic numbers and identical proton counts within their nuclei. However, they possess different mass numbers due to varying counts of uncharged neutrons. Because atomic chemical behavior depends on electron configurations governed by proton numbers, isotopes share chemical properties while differing in physical characteristics and nuclear stabilities.

4. (C) The properties of a compound are an average of the properties of its constituent elements.
Chemical compounds possess distinct physical and chemical characteristics that are entirely unique and differ from those of their constituent elements. A compound is formed by chemical bonding between atoms in fixed proportions by mass, altering chemical structure completely. Therefore, properties are not a mathematical average or combination of the individual element properties, whereas mixtures retain constituent properties.

5. (C) 0.4 M
Molarity is defined as moles of solute divided by solution volume in litres. The number of moles in four grams of sodium hydroxide equals mass divided by molar mass, which is four divided by forty, giving one-tenth mole. Converting two hundred fifty millilitres to litres yields one-quarter litre. Dividing one-tenth mole by one-quarter litre yields zero point four molar concentration.

6. (B) II and III only
Molality measures moles of solute per kilogram of solvent and remains independent of temperature because mass does not change with temperature. Normality depends on equivalent weight, which varies based on chemical reaction context. Molarity, not molality, is defined as moles of solute per litre of solution. Thus, statement one is incorrect while statements two and three are scientifically accurate.

7. (C) 2.0 N
Normality is calculated by multiplying molarity by the n-factor, which represents the acidity or basicity of the chemical compound involved. Sulphuric acid is a dibasic acid capable of donating two hydrogen protons per molecule in aqueous solution, giving an n-factor of two. Multiplying a molarity of one molar by an n-factor of two yields a two normal solution concentration.

8. (C) P-4, Q-2, R-1, S-3
According to Arrhenius theory, acids release hydrogen ions in aqueous media. The Bronsted-Lowry concept defines bases as proton acceptors. The Lewis theory expands acid-base chemistry beyond proton transfer, defining Lewis acids as electron pair acceptors and Lewis bases as electron pair donors. Matching these fundamental definitions pairs each theoretical concept correctly with its corresponding primary functional description.

9. (D) Boron trifluoride (BF_3)
Boron trifluoride functions as a Lewis acid because central boron possesses an incomplete electron octet containing only six valence

Click Here to Buy book on Amazon

89. Iodometric titration is an indirect method of volumetric analysis involving iodine. It is primarily classified as a:
(A) Complexometric titration
(B) Acid-base titration
(C) Precipitation titration
(D) Redox titration

90. In a chemical laboratory, the Safety Data Sheet (SDS) for a chemical like concentrated nitric acid is primarily consulted to determine:
(A) Safety hazards, handling procedures, and emergency first-aid protocols.
(B) The commercial cost of procurement and vendor distribution policies for laboratory supplies.
(C) The chemical's maximum theoretical yield when used in organic synthetic reactions.
(D) The historical background and chronological timeline of the chemical's discovery.

www.nodia.in

NODIA

19. (A) Platinum-Iridium electrode
Standard reference electrodes used in potentiometric pH determinations must maintain a constant, stable potential. Common standard reference electrodes include the saturated calomel electrode, silver/silver chloride electrode, and standard hydrogen electrode. A platinum-iridium electrode lacks stable reference potential characteristics and is typically utilized as an inert indicator or working electrode rather than a standard reference electrode.

20. (C) The weak acid concentration equals its conjugate base concentration.
Buffer capacity refers to the ability of a solution to resist changes in pH upon addition of acid or base. Maximum buffering efficiency occurs when the concentration of the weak acid equals the concentration of its conjugate base. Under this condition, the logarithmic ratio term in the Henderson-Hasselbalch equation equals zero, making solution pH equal to acid pKa.

21. (B) 4.76
According to the Henderson-Hasselbalch equation, pH equals pKa plus the logarithm of the ratio of conjugate base concentration to weak acid concentration. When equimolar concentrations of acetic acid and sodium acetate are mixed, the ratio equals one. Since the logarithm of one is zero, the calculated pH equals the acid pKa value, which is precisely four point seven six.

22. (C) I and II only
Carbonic acid and bicarbonate form the dominant extracellular buffer system in blood plasma, while phosphate buffering operates primarily within intracellular fluid. Haemoglobin and other proteins act as major physiological buffers due to ionisable amino acid side chains. Consequently, statement three is incorrect because haemoglobin contributes significantly to blood buffering capacity, whereas statements one and two are factually correct.

23. (B) A weak acid and its salt with a strong base
An acidic buffer solution maintains a pH below seven and is prepared by combining a weak acid with its conjugate base salt derived from a strong base, such as acetic acid and sodium acetate. Mixing strong acids or strong bases fails to create reversible buffer action. Weak bases mixed with their salts form basic buffer solutions rather than acidic buffers.

24. (C) The point at which equivalents of acid exactly equal equivalents of base.
The equivalence point in an acid-base titration is the theoretical point where stoichiometrically equivalent amounts of acid and base have reacted completely. This represents total chemical neutralization. In contrast, the endpoint is the experimental point signaled by an indicator color change, which may occur at neutral, acidic, or basic pH depending on reactant strengths and indicator transition range.

25. (B) 4 to 10
In strong acid versus strong base titrations, addition of minute titrant amounts near the equivalence point causes a sudden, steep inflection in solution pH. This sharp pH jump spans approximately from pH four to ten. Because of this broad transition range, indicators changing colors within this interval, such as phenolphthalein and methyl orange, provide highly accurate endpoint detection.

26. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Phenolphthalein exhibits a visual color transition between pH eight point two and ten point zero. In strong acid-strong base titrations, the steep pH jump near the equivalence point spans from pH four to ten. Because this rapid inflection encompasses the working transition range of phenolphthalein, it serves as an excellent indicator, making both statements correct and logically related.

27. (B) Point of inflection with the steepest slope.
A titration curve records pH plotted against added titrant volume. The equivalence point corresponds mathematically to the inflection point of the sigmoid curve, where the slope reaches its absolute maximum. At this point, tiny titrant increments cause maximum pH changes. Flat or horizontal regions represent buffer zones rather than equivalence points, while conductance minimums pertain specifically to conductometric analytical methods.

28. (B) IV only
Universal indicators show continuous color changes over broad pH ranges, making them suitable for pH estimation but unsuitable for

Downloaded from www.pdf.tube

precise quantitative titrations requiring sharp endpoints. Statements one, two, and three correctly describe indicator suitability for strong acid-weak base, weak acid-strong base, and weak acid-weak base titrations. Therefore, statement four is the only incorrect assertion regarding volumetric analysis procedures.

29. (B) Photograph the stain in situ → Allow to air dry at room temperature without sunlight → Pack in a clean, dry glass or plastic container → Seal and forward with chain of custody.
Proper forensic evidence preservation requires documenting stains in place before disturbance. Evidence should be dried at room temperature without exposure to direct sunlight or heat to avoid degradation. Packing in clean glass or plastic containers prevents cross-contamination, while maintaining strict chain-of-custody protocols ensures legal admissibility. Washing or neutralizing physical evidence alters chemical evidence integrity permanently.

30. (C) Sulphuric acid
Sulphuric acid reacts with barium chloride in aqueous solutions to yield a dense white precipitate of barium sulphate. Barium sulphate is insoluble in dilute hydrochloric acid, forming the basis of a confirmatory chemical test for sulphate anions. Hydrochloric, nitric, and acetic acids do not form insoluble barium salts under these qualitative test conditions.

31. (D) Sulphuric acid
Concentrated sulphuric acid was historically named "Oil of Vitriol" by early chemists because it was originally prepared by distilling green vitriol, which is iron sulphate crystals. It exists as an oily, viscous liquid possessing powerful dehydrating, corrosive, and oxidizing properties. Other mineral acids like hydrochloric, nitric, and phosphoric acids carry distinct historical and chemical names.

32. (B) 3:1
Aqua regia is a potent corrosive reagent prepared by mixing concentrated hydrochloric acid and concentrated nitric acid in a three to one volumetric ratio. Nitric acid acts as an oxidizer while hydrochloric acid supplies chloride ions to form complex chloraurate anions, enabling the dissolution of noble metals like gold and platinum.

33. (A) I and II only
Sulphuric acid causes severe dehydration, forming dark charred eschars on cutaneous tissue. Nitric acid produces characteristic yellow lesions through the xanthoproteic reaction with aromatic amino acids in cutaneous proteins. Strong alkalis cause liquefactive necrosis, whereas hydrochloric acid causes coagulative necrosis. Therefore, statements one and two accurately describe acid burn characteristics, while statement three is incorrect.

34. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Ingested alkalis cause liquefactive necrosis, saponifying membrane fats and denaturing proteins. This process dissolves tissue, facilitating deep esophageal penetration and transmural perforation. Conversely, acids induce coagulative necrosis, creating a protective proteinaceous eschar that limits deep tissue penetration. Thus, both statements are factually correct, with the physiological mechanism in the reason explaining the elevated danger of alkali ingestion.

NODIA

35. (A) Any acidic or corrosive substance capable of causing bodily injury or disfigurement.
Under legal provisions concerning acid violence, an "acid" is defined broadly to include any corrosive or acidic substance capable of inflicting bodily harm, tissue necrosis, or permanent disfigurement. The legal definition is not restricted to specific chemical thresholds, narrow pH values, or inorganic mineral acids, thereby covering organic acids, alkalis, and miscellaneous corrosive chemical agents.

36. (C) Picric acid
Picric acid, chemically known as two, four, six-trinitrophenol, is an aromatic organic acid that causes chemical skin staining and tissue necrosis. Historically utilized as a military explosive under trade names like Lyddite, it exhibits strong acidic properties due to three electron-withdrawing nitro groups attached to the phenol ring, stabilizing the conjugate phenoxide anion.

37. (A) Salt formed by complete replacement of acid hydrogen atoms by a metal or ammonium ion.
A normal salt is produced when all ionisable hydrogen atoms of an acid are completely replaced by metallic cations or ammonium ions during chemical neutralization. Normal salts contain no replaceable hydrogen ions or hydroxyl

groups, distinguishing them from acidic salts containing remaining acidic hydrogen or basic salts containing unneutralized hydroxyl groups.

38. (D) P-3, Q-4, R-2, S-1
Sodium bicarbonate contains replaceable hydrogen, classifying it as an acidic salt. Basic copper carbonate contains hydroxyl ions, acting as a basic salt. Mohr's salt is a crystalline double salt comprising ferrous sulphate and ammonium sulphate. Potassium ferrocyanide contains a complex coordination ion that remains intact in solution, correctly identifying it as a complex salt.

39. (B) Basic, because of the hydrolysis of the carbonate ion.
Sodium carbonate is a salt derived from a strong base, sodium hydroxide, and a weak acid, carbonic acid. In aqueous solution, the carbonate anion undergoes anionic hydrolysis by reacting with water to produce hydrogen carbonate anions and excess hydroxyl ions. This accumulation of free hydroxyl ions shifts the solution pH above seven, creating an alkaline solution.

40. (C) Almost no hydrolysis
Salts derived from strong acids and strong bases, such as sodium chloride, dissociate completely in aqueous solution into hydration-stabilized cations and anions. Neither the sodium cation nor the chloride anion reacts significantly with water molecules to alter hydrogen or hydroxyl ion concentrations. Consequently, these salts undergo virtually no salt hydrolysis, yielding neutral aqueous solutions with pH seven.

41. (B) III only
The solubility product constant applies strictly to sparingly soluble salts in saturated equilibrium systems and depends directly on temperature. Chemical precipitation occurs whenever the experimental ionic product exceeds the solubility product value. The common ion effect suppresses ionization and decreases salt solubility rather than increasing it. Therefore, statement three is incorrect, making it the right selection.

42. (A) Weak electrolyte by the addition of a strong electrolyte containing a common ion.
The common ion effect describes the suppression of ionization of a weak electrolyte upon adding a strong electrolyte that provides a shared ion. According to Le Chatelier's principle, introducing excess common ions shifts the dissociation equilibrium backward toward undissociated neutral molecules, decreasing ionization degree and lowering solubility in saturated solution systems.

43. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
In qualitative analysis, Group II cations possess extremely small solubility products for their sulphides. Adding dilute hydrochloric acid introduces common hydrogen ions, suppressing hydrogen sulphide dissociation via the common ion effect. This lowers sulphide ion concentration sufficiently to precipitate only Group II sulphides without precipitating Group IV sulphides, validating both statements and their direct logical relationship.

44. (B) Lower
Dissolving silver chloride in sodium chloride solution introduces additional chloride ions into the dissolution equilibrium. Due to the common ion effect, these excess chloride ions shift the dissolution reaction backward toward undissolved solid silver chloride, significantly reducing the overall solubility of silver chloride compared to its equilibrium solubility measured in pure water.

45. (A) II, IV, III, I
The standard inorganic qualitative analysis scheme precipitates cations sequentially by group. Group I cations precipitate as chlorides using dilute hydrochloric acid. Group II cations precipitate as sulphides using hydrogen sulphide in acidic medium. Group III cations precipitate as hydroxides using ammonium hydroxide with ammonium chloride. Group IV cations precipitate as sulphides in basic medium using hydrogen sulphide with ammonium hydroxide.

46. (C) P-2, Q-4, R-1, S-3
In qualitative cation separation, Group I contains silver, lead, and mercurous ions precipitated by hydrochloric acid. Group II includes copper, cadmium, lead, and bismuth precipitated as sulphides in acid. Group III comprises ferric, aluminium, and chromium ions precipitated as hydroxides. Group IV contains zinc, manganese, cobalt, and nickel ions precipitated as sulphides in basic conditions.

Click Here to Buy book on Flipkart

Bronsted-Lowry acid by donating a proton, while another water molecule acts as a base by accepting it, forming hydronium and hydroxide ions in dynamic chemical equilibrium.

67. (A) Adjusted to be much lower than the pKa of the drug.
Organic solvent extraction depends on chemical lipophilicity. A weak organic acid drug exists predominantly in its un-ionized, non-polar form when aqueous solution pH is suppressed significantly below its pKa value. In un-ionized form, the drug exhibits high partition coefficients toward organic solvents, maximizing extraction efficiency from the polar aqueous biological matrix.

68. (C) Valence shell
The valency of an element represents its chemical combining capacity, which is fundamentally dictated by the number of electrons located within its outermost electronic shell, known as the valence shell. Valence electrons participate directly in chemical bonding through electron loss, gain, or sharing to achieve stable octet configurations, whereas inner shell electrons remain unreactive.

69. (A) Base
Bases produce aqueous solutions containing mobile hydroxyl ions that conduct electric currents. Alkaline solutions exhibit physical properties such as turning red litmus paper blue, feeling slippery or soapy to touch, and reacting with acids to form neutral salts. These physical and chemical characteristics uniquely define basic compounds according to classical acid-base chemical definitions.

70. (D) Produces H^+ ions in aqueous solution.
The classical Arrhenius theory defines an acid specifically as a chemical substance containing hydrogen that dissociates in water to yield hydrogen ions. This theoretical framework requires aqueous solvent media, limiting acid classification to species producing aqueous hydrogen or hydronium ions, unlike broader concepts based on proton or electron pair transfer mechanisms.

71. (B) $Ka \times Kb = Kw$
In conjugate acid-base pairs, the acid dissociation constant Ka and conjugate base dissociation constant Kb are related through water self-ionization. Multiplying the Ka expression of a weak acid by the Kb expression of its conjugate base cancels species terms, yielding the ionic product of water Kw, which equals ten to minus fourteen at twenty-five degrees Celsius.

72. (C) It fails to explain acid-base behavior in non-aqueous solvents.
A primary limitation of Arrhenius theory is its complete reliance on aqueous media for defining acids and bases. It fails to account for acid-base neutralizations occurring in non-aqueous solvents or gas-phase reactions, such as reaction between ammonia and hydrogen chloride gases, and cannot explain basicity of substances lacking hydroxyl groups like ammonia.

73. (D) $pOH + pH = 14$ at 25°C.
The pOH represents the negative logarithm of hydroxyl ion concentration in aqueous solutions. Taking negative logarithms of both sides of the ionic product equation of water shows that the sum of pH and pOH always equals fourteen at twenty-five degrees Celsius. As solution basicity increases, hydroxyl concentration rises, causing pOH to decrease.

74. (A) 4.0 and 7.0
Calibrating a laboratory pH meter requires standard reference buffers that bracket the anticipated measurement range. For measurements within acidic ranges, standard buffer solutions with pH values of four point zero and seven point zero are used. Buffer seven establishes the zero offset point, while buffer four calibrates electronic response slope across acidic solution ranges.

75. (B) Maintain electrical neutrality by allowing ion migration.
A salt bridge in an electrochemical cell contains an inert electrolyte gel, such as potassium chloride in agar. It completes the electrical circuit while maintaining charge neutrality within both half-cell compartments. As redox reactions occur, ions migrate across the salt bridge to neutralize charge buildup, preventing cell polarization without allowing direct chemical mixing of solutions.

76. (C) 20:1
Blood pH is regulated by the carbonic acid-bicarbonate buffer system. Applying the Henderson-Hasselbalch equation at physiological

NODIA

STUDYING FROM PDFs?

THINK AGAIN.

If you are studying only from PDFs,
you are wasting valuable time.

Research shows that learning from

PRINTED BOOKS has up to

4× HIGHER RETENTION

than studying from screens.

PRINT BOOK = BETTER MEMORY

PDF = LOWER RETENTION

Those who study from **PRINTED BOOKS**
move **AHEAD.**

Others are left **BEHIND**
in competition.

In competitive exams,
being average is not enough.

STAY ONE STEP AHEAD.

appearance of a pale pink color indicates slight excess titrant.

57. (D) Phenolphthalein
Phenolphthalein is an acid-base indicator that responds strictly to changes in solution pH rather than oxidation-reduction potentials. Diphenylamine and ferroin are true redox indicators changing color upon oxidation or reduction. Starch is used specifically in iodometric redox titrations to detect triiodide ions. Thus, phenolphthalein is not utilized as a redox titration indicator.

58. (A) Masking agents
Masking agents are chemical reagents added during complexometric titrations to selectively form stable complexes with interfering metal ions. By binding potential interfering cations into soluble non-reactive complexes, masking agents prevent these secondary ions from reacting with EDTA or metallochromic indicators, thereby increasing titration selectivity for the specific target metal analyte.

59. (B) Watch glass
Burettes, pipettes, and volumetric flasks represent precision calibrated volumetric glassware designed specifically to measure accurate liquid volumes during quantitative titrimetric procedures. Conversely, a watch glass is a non-volumetric circular glass vessel used primarily for holding solids during weighing, covering chemical beakers, or evaporating small solvent droplets in general laboratory settings.

60. (B) Slowly add acid to water with continuous stirring.
Diluting concentrated sulphuric acid releases substantial hydration heat in an intensely exothermic reaction. To safely dissipate heat, acid must always be added slowly to a larger volume of water with continuous stirring. Adding water directly to concentrated acid can cause localized boiling, resulting in dangerous steam generation and chemical splattering.

61. (A) Flush the affected skin with running water for 15 minutes.
Immediate emergency first aid for chemical skin contamination requires immediate, continuous flushing with copious amounts of running water for at least fifteen minutes. Copious water dilutes and removes corrosive acid rapidly while cooling affected tissues. Attempting direct chemical neutralization with concentrated alkalis or applying occlusive ointments generates secondary thermal or chemical tissue injury.

NODIA

62. (C) Alkalis react with glass to form silicates, fusing the stopper.
Concentrated strong alkalis dissolve silicon dioxide in borosilicate glass over time, producing soluble sodium or potassium silicates. When stored in glass-stoppered bottles, alkaline solution creeping into the ground-glass neck forms silicate compounds that crystallize and permanently fuse the stopper to the bottle neck. Plastic or rubber stoppers prevent this chemical binding.

63. (D) Solid sodium bicarbonate
Minor hydrochloric acid laboratory spills are safely neutralized using solid sodium bicarbonate. Sodium bicarbonate is a mild amphoteric base that neutralizes acid while generating carbon dioxide gas and non-hazardous sodium chloride salt. Using strong bases like sodium hydroxide can cause violent exothermic reactions, whereas water or organic solvents fail to neutralize corrosive acidic hazard properties.

64. (C) 58.5 g
One molar solution contains one mole of solute per litre of solution. The molar mass of sodium chloride is calculated by adding the atomic mass of sodium, twenty-three, to chlorine, thirty-five point five, yielding fifty-eight point five grams per mole. Thus, preparing one litre of one molar solution requires exactly fifty-eight point five grams of sodium chloride.

65. (B) 1.0×10^{-14}
The ionic product of water represents the equilibrium constant for self-ionization of water. At standard temperature of twenty-five degrees Celsius, the concentration of hydrogen ions equals hydroxyl ion concentration, both measuring ten to the minus seven moles per litre. Multiplying these concentrations gives an equilibrium constant value of one point zero times ten to the power minus fourteen.

66. (D) Autoprotolysis
Autoprotolysis, or self-ionization, is a chemical process where identical amphiprotic solvent molecules transfer protons between each other. In pure water, one water molecule acts as a

www.nodia.in

volatile barium salts undergo thermal excitation and emit light resulting in a characteristic apple-green flame color. Sodium produces a bright persistent yellow, potassium yields lilac, and strontium imparts a deep crimson red flame coloration.

87. (B) To suppress NH_4OH ionisation via common ion effect, preventing Group IV/V precipitation.
In qualitative cation analysis, ammonium chloride is added before ammonium hydroxide to supply common ammonium ions. This common ion effect suppresses ammonium hydroxide dissociation, lowering hydroxyl ion concentration. This controlled concentration is sufficient to exceed solubility products of Group III metal hydroxides while preventing unwanted premature precipitation of higher group hydroxides.

88. (C) Entrapment of normally soluble impurities during the formation of a precipitate.
Coprecipitation is a gravimetric phenomenon where normally soluble impurities precipitate alongside the primary analyte during solid formation. This occurs through occlusion, mechanical entrapment, surface adsorption, or mixed-crystal formation within the growing precipitate lattice. Coprecipitation introduces positive or negative weighing errors, requiring digestion, washing, or reprecipitation steps to minimize analytical errors.

89. (D) Redox titration
Iodometric titration is an indirect redox titration method used to quantify oxidizing agents. The oxidizing analyte reacts with excess iodide ions to liberate elemental iodine. Liberated iodine is then titrated against a standardized sodium thiosulphate reducing solution using starch indicator, relying on electron transfer reactions between oxidizing and reducing chemical species.

90. (A) Safety hazards, handling procedures, and emergency first-aid protocols.
A Safety Data Sheet provides comprehensive chemical safety documentation for laboratory hazardous substances. It details physical hazards, health risks, personal protective equipment requirements, safe storage protocols, spill response actions, and emergency first-aid procedures. Chemical users consult Safety Data Sheets prior to handling corrosive chemicals like concentrated nitric acid to minimize exposure risks.

Downloaded from www.pdf.tube

pH seven point four with a carbonic acid pKa of six point one gives a pH difference of one point three. Taking antilogarithm of one point three yields approximately a twenty to one ratio of bicarbonate ions to carbonic acid.

77. (A) Acid + Base → Salt + Water
A classic neutralization reaction occurs when an acid reacts with a base to form an ionic salt and liquid water. Hydrogen ions supplied by the acid combine with hydroxyl ions supplied by the base to form neutral water molecules, eliminating both acidic and basic chemical properties from the final resulting reaction solution.

78. (C) Less than 7.0
Titrating a weak base like ammonia against a strong acid like hydrochloric acid produces ammonium salt at the equivalence point. The weak conjugate acid ammonium cation undergoes cationic hydrolysis in water, yielding hydronium ions. This hydrolysis causes the equivalence point pH to fall below seven point zero into the acidic pH region.

79. (D) Nitrate and nitrite ions
The diphenylamine test is a spot test utilized in forensic analysis to detect nitrate and nitrite species found in gunshot residues and smokeless powder residues. Diphenylamine dissolves in concentrated sulphuric acid and undergoes oxidation by nitrate or nitrite ions, forming a characteristic deep blue quinoid oxidation product that confirms oxidizing nitrogen species.

80. (C) Accepts a proton from water, generating OH^- ions.
According to Bronsted-Lowry theory, ammonia functions as a weak base in water by accepting a proton from a water molecule. The lone pair of electrons on the nitrogen atom forms a coordinate bond with a hydrogen proton, producing an ammonium cation and leaving a free hydroxyl anion, which imparts basicity to the solution.

81. (B) Concentrated sulphuric acid
Concentrated sulphuric acid acts as a powerful dehydrating agent and corrosive acid. Upon ingestion, it strips water molecules rapidly from organic mucosal tissue, carbonizing tissue proteins and carbohydrates. Post-mortem pathological examination reveals extensive, uniform black charring and mucosal destruction across the gastric lining without tissue liquefaction typical of alkaline corrosives.

82. (D) Extraction of water and coagulation of tissue proteins.
Strong mineral acids exert corrosive effects on living tissues primarily through rapid water extraction due to strong hygroscopic affinity and protein coagulation. Acids denature cellular proteins, causing precipitation that forms a thick, coagulated proteinaceous crust known as an eschar. This coagulative process contrasts with the saponification and liquefaction produced by strong alkalis.

83. (A) $Na_2CO_3.10H_2O$
Washing soda is a basic chemical compound chemically identified as hydrated sodium carbonate decahydrate, represented formulaically as $Na_2CO_3.10H_2O$. It consists of basic sodium carbonate combined with ten discrete molecules of hydration water. Sodium bicarbonate represents baking soda, sodium hydroxide represents caustic soda, and anhydrous sodium sulphate lacks these alkaline carbonate characteristics completely.

84. (C) Double salts dissociate completely into simple ions in water, while complex ions remain intact.
Double salts and complex salts differ fundamentally in aqueous dissolution behavior. Double salts, such as Mohr's salt or alum, dissociate completely into their individual constituent simple ions in water. In contrast, complex salts contain stable coordinate complex ions that retain structural identity in aqueous solution, failing to release constituent central metal ions independently.

85. (A) Bromide
Silver nitrate testing distinguishes halide ions based on precipitate colors and ammonium hydroxide solubility. Chloride forms a white precipitate fully soluble in dilute ammonium hydroxide. Bromide forms a pale yellow silver bromide precipitate sparingly soluble in dilute ammonium hydroxide but soluble in concentrated ammonium hydroxide. Iodide yields yellow silver iodide insoluble in ammonium hydroxide.

86. (D) Barium (Ba^{2+})
Flame photometry utilizes characteristic atomic emission spectra to detect metal cations. When introduced into a non-luminous Bunsen flame,

NODIA

47. (D) Barium (Ba^{2+})
Group I basic radicals comprise cations that form insoluble chlorides when treated with dilute hydrochloric acid, specifically silver, lead, and mercurous ions. Barium chloride is soluble in water, so barium cations do not precipitate in Group I; instead, barium belongs to Group V and precipitates as an insoluble carbonate upon adding ammonium carbonate.

48. (C) Nitrate (NO_3^-)
The Brown Ring test specifically confirms nitrate anions in solution. Freshly prepared ferrous sulphate solution is added to the sample, followed by carefully layering concentrated sulphuric acid along the test tube wall. Nitric oxide formed by nitrate reduction reacts with unoxidized ferrous ions to produce a brown complex ring, nitrosyl iron sulphate, at the liquid junction.

49. (B) Chloride
The chromyl chloride test specifically confirms chloride ions in qualitative analysis. Heating a dry chloride salt with potassium dichromate and concentrated sulphuric acid generates reddish-brown vapors of chromyl chloride gas. Passing these vapors into sodium hydroxide yields a yellow sodium chromate solution, which forms a yellow lead chromate precipitate upon adding lead acetate.

50. (C) I and III only
Carbonate anions effervesce with dilute acids releasing carbon dioxide gas. Acetates emit a characteristic vinegar odor of acetic acid when heated with concentrated sulphuric acid. Sulphate anions yield a white barium sulphate precipitate with barium chloride that remains insoluble in concentrated hydrochloric acid. Therefore, statement two is incorrect while statements one and three are correct.

51. (A) Definite proportions
Gravimetric analysis relies fundamentally on converting an analyte into a pure compound of known, constant chemical composition. This relies on the law of definite proportions, which states that a chemical compound always contains its constituent elements in a fixed, definite mass ratio. This fixed stoichometry enables precise mass calculations of the target analyte element.

52. (C) Complexometric titration
Complexometric titration involves forming a soluble, stable coordination complex between metal analyte ions and a titrant ligand, most commonly ethylenediaminetetraacetic acid. Metallochromic indicators signal the titrimetric endpoint through distinct color changes when free metal ions are fully complexed, enabling precise quantitative estimation of polyvalent metal cation concentrations in analytical samples.

53. (B) Precipitation → Digestion → Filtration → Washing → Drying/Ignition → Weighing
Standard gravimetric analysis follows a logical sequential laboratory procedure: initial chemical precipitation forms the insoluble product; thermal digestion promotes particle growth; filtration separates the precipitate; washing removes adsorbed impurities; drying or high-temperature ignition yields a stable, pure chemical compound; and final precise analytical balance weighing enables accurate analyte mass determination.

54. (D) Low molecular weight
Primary standards require high chemical purity, atmospheric stability without hygroscopic absorption, and high solubility in titration media. A high molecular weight is highly desirable rather than a low molecular weight because a higher mass per mole significantly minimizes relative weighing errors when measuring precise titrimetric amounts on analytical laboratory balances.

55. (B) Eriochrome Black T
Eriochrome Black T is a complex organic dye widely employed as a metallochromic indicator in complexometric titrations with EDTA, particularly for measuring total water hardness cations like calcium and magnesium. It binds metal cations to form a wine-red complex, turning distinctly blue when EDTA displaces the indicator at the titrimetric endpoint.

56. (C) Colourless
Potassium permanganate acts as a self-indicator in redox titrations due to its intense purple coloration. In strongly acidic environments, deep purple permanganate anions undergo reduction to form manganese divalent cations, which are virtually colorless in dilute solution. Upon reaching the equivalence point, the persistent

Click Here to Buy book on Amazon

CHAPTER 20

Basics of Organic and Inorganic Chemistry

1. Which of the following best defines the primary scope of organic chemistry in forensic science?
(A) The analysis of strictly inorganic soil minerals at a crime scene
(B) The identification and characterization of carbon-containing compounds such as drugs, poisons, and synthetic fibres
(C) The study of radioactive isotopes used in radiometric dating
(D) The determination of elemental profiles in glass fragments using plasma spectroscopy

2. The unique ability of carbon atoms to form long chains and rings, which is foundational to the vast number of organic molecules encountered in forensic analysis, is known as:
(A) Allotropy
(B) Polymerization
(C) Isomerization
(D) Catenation

3. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Carbon compounds exhibit a vast structural diversity.
Reason (R): Carbon atoms possess tetravalency and undergo sp, sp^2, and sp^3 hybridization, allowing them to form single, double, and triple bonds with other carbon atoms.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

4. In a suspected arson case, a forensic chemist isolates a compound containing a benzene ring. Under which broad category of organic compounds does this primarily fall?
(A) Alicyclic compounds
(B) Aliphatic compounds
(C) Aromatic compounds
(D) Heterocyclic compounds

5. Match the organic functional groups in List I with their correct IUPAC suffixes in List II.
List I: (Functional Group)
P. Aldehyde
Q. Ketone
R. Alcohol
S. Carboxylic Acid
List II: (IUPAC Suffix)
1. -oic acid
2. -al
3. -ol
4. -one
(A) P-2, Q-4, R-3, S-1
(B) P-3, Q-4, R-2, S-1
(C) P-2, Q-1, R-3, S-4
(D) P-4, Q-2, R-1, S-3

6. What is the correct IUPAC name for the compound commonly known as isobutane?
(A) 2-Methylbutane
(B) 2,2-Dimethylpropane
(C) Butan-2-ol
(D) 2-Methylpropane

7. Ethanol (CH_3CH_2OH) and dimethyl ether (CH_3OCH_3) have the same molecular formula (C_2H_6O) but belong to different chemical families. This is an example of which type of isomerism?
(A) Chain isomerism
(B) Functional isomerism
(C) Position isomerism
(D) Metamerism

8. Consider the following statements regarding enantiomers:
I. They are non-superimposable mirror images of each other.
II. They rotate plane-polarized light in opposite directions by equal amounts.
III. They always have identical biological and pharmacological properties in the human body.
Which of the given statements is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only

NODIA

(D) I, II, and III

9. A molecule possesses chiral centers but exhibits an internal plane of symmetry, rendering it optically inactive. Such a compound is known as a:
(A) Racemic mixture
(B) Diastereomer
(C) Conformational isomer
(D) Meso compound

10. Which type of structural hybridization is present in the carbon atoms of an alkane, such as methane?
(A) sp^3
(B) sp
(C) sp^2
(D) sp^3d

11. During the chemical synthesis of an illicit drug, hydrogen chloride is added to an asymmetrical alkene. According to Markownikoff's rule, the halogen atom predominantly attaches to which carbon?
(A) The carbon with the greatest number of hydrogen atoms
(B) The carbon with the fewest number of hydrogen atoms
(C) The terminal carbon of the longest chain
(D) Any available carbon randomly

12. Choose the correct sequence of increasing boiling points for the following compounds of comparable molecular mass.
(A) Alkane < Ether < Ketone < Alcohol
(B) Ether < Alkane < Alcohol < Ketone
(C) Alcohol < Ketone < Ether < Alkane
(D) Alkane < Alcohol < Ether < Ketone

13. Which of the following best explains why phenol is more acidic than aliphatic alcohols?
(A) The phenoxide ion is stabilized by resonance.
(B) The hydroxyl oxygen in phenol is sp^3 hybridized.
(C) Aliphatic alcohols have stronger hydrogen bonds.
(D) Phenol undergoes rapid electrophilic additions.

14. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Tollen's reagent is routinely used to distinguish aldehydes from ketones.
Reason (R): Aldehydes are easily oxidized to carboxylic acids by ammoniacal silver nitrate, producing a silver mirror, whereas ketones are generally resistant to such mild oxidation.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

15. The Carbylamine test is an important qualitative laboratory test used by forensic chemists to detect the presence of:
(A) Secondary amines
(B) Tertiary amines
(C) Quaternary ammonium salts
(D) Primary amines

16. Match the organic reactions in List I with their primary characteristics or products in List II.
List I: (Organic Reaction)
P. Friedel-Crafts reaction
Q. Cannizzaro reaction
R. Esterification
S. Diazotization
List II: (Characteristic / Product)
1. Formation of diazonium salts from primary aromatic amines
2. Reaction of alcohols and carboxylic acids
3. Self-oxidation-reduction of aldehydes lacking alpha-hydrogen
4. Alkylation or acylation of an aromatic ring
(A) P-4, Q-3, R-2, S-1
(B) P-3, Q-4, R-1, S-2
(C) P-4, Q-2, R-3, S-1
(D) P-1, Q-3, R-2, S-4

17. In forensic toxicology, which of the following is commonly known as "wood alcohol" and is a potent poison that can cause blindness by damaging the optic nerve?
(A) Ethanol
(B) Methanol
(C) Isopropanol
(D) Butanol

18. Nitration of benzene is a classic example of an electrophilic aromatic substitution reaction. The active electrophile generated by the nitrating mixture (concentrated HNO_3^+ concentrated H_2SO_4) is:
(A) NO_2^-
(B) NO_3^-
(C) NO^+

Downloaded from www.pdf.tube

(D) NO_2^+

19. Consider the following statements regarding carboxylic acids:
I. They turn blue litmus paper red.
II. They react with sodium bicarbonate to release carbon dioxide gas.
III. Their boiling points are lower than those of corresponding alcohols of similar molecular weight.
IV. The carbonyl carbon in carboxylic acids is sp^2 hybridized.
Which combination of statements is correct?
(A) I, II, and III only
(B) I, II, and IV only
(C) II, III, and IV only
(D) I, III, and IV only

20. Which common explosive compound is formed by the exhaustive nitration of toluene?
(A) RDX
(B) PETN
(C) TNT
(D) HMX

21. Which functional group is formed when a carboxylic acid reacts with an amine, a linkage that is also fundamental to the structure of proteins?
(A) Amide
(B) Ester
(C) Ether
(D) Anhydride

22. Heterocyclic compounds contain at least one atom other than carbon in their ring structure. Which of the following is an oxygen-containing heterocyclic compound?
(A) Pyridine
(B) Pyrrole
(C) Thiophene
(D) Furan

23. In forensic drug chemistry, alkaloids represent a major class of substances. What is the fundamental chemical defining feature of an alkaloid?
(A) A long, fully saturated aliphatic hydrocarbon chain structure
(B) A basic, naturally occurring nitrogenous organic compound
(C) A complex polymer of amino acids linked by peptide bonds
(D) A synthetic ester derivative synthesized from salicylic acid

24. Which general screening reagent is widely used in forensic science laboratories to yield a reddish-brown precipitate confirming the presumptive presence of alkaloids?
(A) Tollen's reagent
(B) Benedict's reagent
(C) Wagner's reagent
(D) Schiff's reagent

25. Match the alkaloids in List I with their corresponding natural sources in List II.
List I: (Alkaloid)
P. Morphine
Q. Quinine
R. Nicotine
S. Cocaine
List II: (Natural Source)
1. Cinchona bark
2. Tobacco leaves
3. Opium poppy (Papaver somniferum)
4. Erythroxylum leaves
(A) P-3, Q-1, R-2, S-4
(B) P-3, Q-2, R-1, S-4
(C) P-1, Q-3, R-4, S-2
(D) P-4, Q-1, R-2, S-3

26. Which alkaloid class does the potent central nervous system stimulant cocaine belong to?
(A) Tropane alkaloids
(B) Pyridine-piperidine alkaloids
(C) Isoquinoline alkaloids
(D) Indole alkaloids

27. Consider the following statements about pyridine:
I. It is a six-membered heterocyclic compound containing one nitrogen atom.
II. It exhibits aromatic character and obeys Huckel's rule.
III. The nitrogen atom in pyridine does not have a lone pair of electrons.
Which combination of statements is correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

NODIA

28. Which essential nitrogenous base pair found in DNA structure represents a purine pairing with a pyrimidine?
(A) Adenine and Guanine
(B) Adenine and Thymine

(C) Cytosine and Thymine
(D) Guanine and Uracil

29. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Pyrrole is a much weaker base than pyridine.
Reason (R): The lone pair of electrons on the nitrogen atom in pyrrole is involved in maintaining the aromaticity of the ring and is not available for protonation.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

30. Epimers are a specific type of stereoisomer common in carbohydrates. D-glucose and D-galactose are epimers that differ in configuration exclusively at which carbon atom?
(A) C-1
(B) C-2
(C) C-4
(D) C-3

31. Carbohydrates are generally classified based on their behavior upon hydrolysis. Sucrose is a common carbohydrate found in forensic evidence like spilled beverages. Under which classification does sucrose fall?
(A) Monosaccharide
(B) Trisaccharide
(C) Polysaccharide
(D) Disaccharide

32. Arrange the following steps of the Lassaigne's test for detecting nitrogen in an organic compound in the correct chronological order:
I. Boil the extract with ferrous sulfate solution and acidify.
II. Plunge the red-hot ignition tube into distilled water in a China dish.
III. Fuse the organic compound with a piece of sodium metal in an ignition tube.
IV. Filter the resulting mixture to obtain the sodium fusion extract.
Which of the following is the correct order?
(A) III, II, IV, I
(B) II, III, I, IV
(C) III, I, II, IV
(D) IV, III, II, I

33. The isoelectric point (pI) of an amino acid is highly relevant in forensic electrophoretic techniques. What does the isoelectric point represent?
(A) The pH at which all functional groups are fully protonated
(B) The pH at which an amino acid has zero net electrical charge
(C) The specific temperature at which an amino acid denatures
(D) The exact concentration at which an amino acid crystallizes

34. Saponification is a chemical reaction used historically to manufacture soap, but it is also a post-mortem change known as adipocere formation. Chemically, saponification is the:
(A) Acidic hydrolysis of complex carbohydrates
(B) Catalytic oxidation of primary alcohols
(C) Chemical reduction of long-chain fatty acids
(D) Alkaline hydrolysis of ester linkages

35. Natural rubber is an important polymer in tire mark analysis. What is the fundamental monomeric unit of natural rubber?
(A) Isoprene
(B) Chloroprene
(C) Styrene
(D) Butadiene

36. Consider the following statements regarding polymers of forensic interest:
I. Kevlar is a highly durable synthetic polyamide used in bullet-resistant vests.
II. Nylon-6,6 is formed by the condensation reaction between adipic acid and hexamethylenediamine.
III. Polystyrene is a natural polymer derived from cellulose.
IV. Polyvinyl chloride (PVC) is widely used in making insulating wire covers and pipes.
Which of the given statements form the correct combination?
(A) I, II, and III only
(B) II, III, and IV only
(C) I, II, and IV only
(D) I, III, and IV only

37. Match the synthetic polymers in List I with their corresponding primary monomers in List II.
List I: (Synthetic Polymer)
P. Teflon (PTFE)
Q. Polypropylene
R. Orlon (PAN)

Click Here to Buy book on Flipkart

S. PVC
List II: (Primary Monomer)
1. Propene
2. Tetrafluoroethylene
3. Vinyl chloride
4. Acrylonitrile
(A) P-2, Q-1, R-4, S-3
(B) P-1, Q-2, R-3, S-4
(C) P-2, Q-4, R-1, S-3
(D) P-3, Q-1, R-4, S-2

38. In a nucleophilic substitution bimolecular (SN2) reaction, the stereochemistry of the product formed from an optically active alkyl halide exhibits:
(A) Complete retention of configuration
(B) Racemization
(C) Diastereomer formation
(D) Complete inversion of configuration

39. Which of the following reagents is most commonly utilized in organic chemistry as a strong reducing agent capable of converting carboxylic acids directly to primary alcohols?
(A) Potassium permanganate ($KMnO_4$)
(B) Lithium aluminium hydride (LiAlH4)
(C) Sodium borohydride ($NaBH_4$)
(D) Pyridinium chlorochromate (PCC)

40. When an alkyl halide undergoes dehydrohalogenation upon treatment with alcoholic potassium hydroxide, it typically forms an alkene. This process is a classic example of:
(A) Free radical substitution
(B) Electrophilic addition
(C) Elimination reaction
(D) Nucleophilic substitution

41. In qualitative organic analysis, the presence of sulfur in an organic compound during Lassaigne's test is confirmed by the addition of sodium nitroprusside. What indicates a positive result?
(A) A dense white precipitate
(B) A bright yellow precipitate
(C) Rapid effervescence of a brown gas
(D) A deep purple coloration

42. Arrange the following alkyl halides in the sequence of their increasing reactivity towards the SN2 mechanism:
I. Tertiary butyl chloride
II. Methyl chloride
III. Isopropyl chloride
IV. Ethyl chloride
(A) I < III < IV < II
(B) II < IV < III < I
(C) I < IV < III < II
(D) III < I < IV < II

43. During Lassaigne's test, if both nitrogen and sulfur are present in the organic compound, the sodium extract upon treatment with Iron(III) chloride gives a blood-red coloration. This is due to the formation of:
(A) Sodium cyanide
(B) Ferric thiocyanate
(C) Ferric ferrocyanide
(D) Sodium sulfate

44. To detect halogens in an organic compound via Lassaigne's extract, the extract is first boiled with concentrated nitric acid and then treated with silver nitrate. Why is it boiled with nitric acid first?
(A) To oxidize all halide ions present into free gaseous halogens
(B) To decompose interfering sodium cyanide and sodium sulfide
(C) To significantly increase the solubility of silver halides
(D) To completely neutralize the extreme alkalinity of the extract

45. In the modern periodic table, which of the following properties generally decreases as you move from left to right across a period?
(A) Atomic radius
(B) Electronegativity
(C) Electron affinity
(D) Ionization enthalpy

46. Consider the following statements about periodic properties:
I. Nitrogen has a higher first ionization enthalpy than oxygen.
II. Fluorine is the most electronegative element in the periodic table.
III. Noble gases have highly negative electron gain enthalpies.
Which combination of statements is correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

47. The s-block elements are known to impart characteristic colors to a non-luminous bunsen

Downloaded from www.pdf.tube

flame, a property utilized in forensic flame tests. Which metal correctly matches its flame color?
(A) Sodium – Intense crimson red
(B) Barium – Characteristic brick red
(C) Copper – Bright golden yellow
(D) Potassium – Characteristic lilac

48. The "inert pair effect" refers to the reluctance of the outermost s-electrons to participate in bonding. This effect is most prominently observed in which group of elements?
(A) Light s-block elements (e.g., Li, Be)
(B) Transition metal elements (e.g., Fe, Co)
(C) Heavy p-block elements (e.g., Pb, Bi)
(D) Lanthanide and actinide inner metals

49. Which naturally occurring crystalline allotrope of carbon, a p-block element, is renowned as the hardest natural substance and acts as an electrical insulator but excellent thermal conductor?
(A) Graphite
(B) Diamond
(C) Fullerene
(D) Graphene

50. Transition metals and their compounds are extensively used as catalysts in both biological systems and industrial processes. What is the primary reason for their catalytic activity?
(A) Presence of completely filled outer d-orbitals
(B) High degree of spontaneous nuclear radioactivity
(C) Large atomic radii that readily absorb ambient heat
(D) Variable oxidation states and complex formation

51. In coordination chemistry, a molecule or ion that can bind to the central metal atom through more than one donor atom forming a ring structure is called a:
(A) Chelating ligand
(B) Monodentate ligand
(C) Ambidentate ligand
(D) Counter ion

52. What is the oxidation state of the central iron atom in the coordination complex Potassium hexacyanoferrate(II), $K_4[Fe(CN)_6]$?
(A) +3
(B) +4
(C) +2
(D) +6

53. Choose the sequence that correctly arranges the given elements in order of their decreasing atomic radii.
(A) Na > Mg > Al > Si
(B) Si > Al > Mg > Na
(C) Na > Al > Mg > Si
(D) Al > Mg > Na > Si

54. A chemical reaction in which a single substance undergoes both oxidation and reduction simultaneously to form two different products is defined as a:
(A) Acid-base neutralization reaction
(B) Single displacement reaction
(C) Organic condensation reaction
(D) Disproportionation reaction

NODIA

55. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Most coordination complexes of transition metals are highly colored.
Reason (R): The presence of unpaired electrons in degenerate d-orbitals allows for d-d electron transitions within the visible region of the light spectrum.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

56. Which heavy metal, classically used as a homicidal poison due to its tastelessness and delayed symptoms, binds to sulfhydryl groups of enzymes and is detected historically by the Marsh test?
(A) Mercury
(B) Lead
(C) Arsenic
(D) Cadmium

57. Consider the following statements about Group 17 elements (Halogens):
I. They all exist as diatomic molecules in their standard state.
II. Iodine is a solid at room temperature and undergoes sublimation.
III. Astatine is a radioactive halogen.
IV. Fluorine shows a wide variety of positive oxidation states such as +1, +3, +5, and +7.
Which combination is correct?
(A) I, II, and III only

(B) II, III, and IV only
(C) I, II, and IV only
(D) I, III, and IV only

58. The standard formulation for gunshot residue (GSR) primers contains compounds of three specific heavy metals. Which combination of elements is considered characteristic of primer GSR?
(A) Lead, Barium, Antimony
(B) Lead, Copper, Zinc
(C) Iron, Barium, Tin
(D) Bismuth, Antimony, Silver

59. Thallium is a highly toxic element that has historically been used in rat poisons and as a murder weapon. It causes a distinct clinical symptom rarely seen with other metal toxicities, which is:
(A) Distinct blue line on the gums
(B) Severe alopecia (hair loss)
(C) Rapid blackening of the skin
(D) Continuous excessive salivation

60. In inorganic qualitative analysis, the Group II cations (e.g., Cu^{2+}, Pb^{2+}, As^{3+}) are precipitated as sulfides by passing H_2S gas through the solution. Why is the solution first acidified with dilute HCl?
(A) HCl oxidizes H_2S gas completely to elemental sulfur
(B) Common ion effect suppresses H_2S ionization
(C) HCl acts as a complexing agent to hold cations
(D) HCl increases pH to alkaline levels for precipitation

61. Which reagent is used in the specific confirmatory test for the presence of nitrate ions in forensic explosives residues, resulting in a distinct "brown ring" at the junction of two liquids?
(A) Fresh $FeSO_4$ solution and concentrated H_2SO_4
(B) Silver nitrate solution and aqueous ammonium hydroxide
(C) Barium chloride solution and dilute hydrochloric acid
(D) Dimethylglyoxime reagent and ammonium hydroxide

62. Atomic Absorption Spectroscopy (AAS) is a sensitive instrumental technique used in forensic laboratories to detect trace heavy metals. The underlying principle of quantitative measurement in AAS is based on:
(A) Bragg's Law
(B) Faraday's Laws of Electrolysis
(C) The Beer-Lambert Law
(D) The Heisenberg Uncertainty Principle

63. In Atomic Absorption Spectroscopy, what is the most common light source used to emit the specific narrow bandwidth of light required to excite the target atoms?
(A) Deuterium lamp
(B) Tungsten-halogen lamp
(C) Xenon arc lamp
(D) Hollow cathode lamp

64. Consider the following rules for assigning oxidation states in inorganic chemistry:
I. The oxidation state of an element in its free or uncombined state is always zero.
II. In most of its compounds, the oxidation state of oxygen is -2.
III. The sum of the oxidation states of all atoms in a polyatomic ion is zero.
Which statement(s) is/are incorrect?
(A) I only
(B) II only
(C) III only
(D) I and III only

65. Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES) is extensively used in the trace elemental profiling of forensic glass evidence. What gas is typically used to generate the high-temperature plasma in an ICP instrument?
(A) Helium
(B) Argon
(C) Nitrogen
(D) Hydrogen

66. The branch of chemistry that deals with the study of reaction rates and the mechanisms by which chemical reactions occur is called:
(A) Chemical Thermodynamics
(B) Electrochemistry
(C) Surface Chemistry
(D) Chemical Kinetics

67. The units for the rate constant (k) of a zero-order reaction are:
(A) mol L-1 s-1
(B) s-1
(C) L mol-1 s-1

Click Here to Buy book on Amazon

possesses an internal plane or center of symmetry. This internal symmetry causes the optical rotation of one half of the molecule to cancel out the optical rotation of the other half, rendering the overall compound optically inactive despite containing stereocenters.

10. (A) sp^3
Alkanes are saturated hydrocarbons containing single covalent bonds between carbon and hydrogen atoms. Each carbon atom in an alkane forms four sigma bonds by mixing one s orbital and three p orbitals, resulting in sp^3 hybridization. This structural geometry creates a symmetrical tetrahedral spatial arrangement with characteristic bond angles of approximately 109.5 degrees.

11. (B) The carbon with the fewest number of hydrogen atoms
Markownikoff rule dictates electrophilic addition of hydrogen halides to asymmetrical alkenes. During this chemical reaction, the hydrogen atom adds to the double bonded carbon containing more attached hydrogen atoms, while the halogen atom attaches predominantly to the double bonded carbon bearing the fewest hydrogen atoms, proceeding via the most stable carbocation intermediate.

12. (A) Alkane < Ether < Ketone < Alcohol
Boiling points depend on intermolecular forces between organic molecules. Nonpolar alkanes possess weak London dispersion forces, giving them low boiling points. Ethers exhibit weak dipole dipole interactions. Ketones feature stronger dipole dipole interactions due to polar carbonyl groups. Alcohols exhibit extensive intermolecular hydrogen bonding, requiring significantly higher energy to boil than corresponding compounds.

13. (A) The phenoxide ion is stabilized by resonance.
Phenol exhibits greater acidity than aliphatic alcohols because loss of a proton generates a phenoxide ion that is stabilized by resonance delocalization of its negative charge across the aromatic ring. In contrast, alkoxide ions from aliphatic alcohols lack resonance stabilization and are destabilized by electron donating alkyl groups, making proton dissociation far less favorable.

14. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Tollen reagent, composed of ammoniacal silver nitrate, serves as a qualitative test to differentiate aldehydes from ketones. Aldehydes undergo oxidation readily to yield carboxylic acids while reducing silver ions to metallic silver, forming a shiny silver mirror on the glass wall. Ketones resist mild oxidation under these conditions due to carbon carbon bond stability.

15. (D) Primary amines
The Carbylamine test is a qualitative chemical test utilized exclusively to identify primary aliphatic and aromatic amines. Heating a primary amine with chloroform and alcoholic potassium hydroxide produces an isocyanide, or carbylamine, which possesses an extremely characteristic and offensive odor. Secondary and tertiary amines do not undergo this reaction due to structural differences.

16. (A) P-4, Q-3, R-2, S-1
Friedel Crafts reactions introduce alkyl or acyl groups onto aromatic rings using Lewis acid catalysts. The Cannizzaro reaction involves self oxidation reduction of non enolizable aldehydes lacking alpha hydrogen atoms. Esterification is the acid catalyzed condensation reaction between alcohols and carboxylic acids forming esters. Diazotization converts primary aromatic amines into diazonium salts using nitrous acid.

17. (B) Methanol
Methanol is commonly referred to as wood alcohol because it was historically produced by destructive distillation of wood. In forensic toxicology, methanol ingestion represents a lethal health hazard. Alcohol dehydrogenase metabolizes methanol into formaldehyde and formic acid, which causes severe metabolic acidosis and selectively damages optic nerves, leading directly to permanent blindness or death.

NODIA

18. (D) NO_2^+
During the electrophilic aromatic substitution nitration of benzene, a mixture of concentrated nitric acid and concentrated sulfuric acid is employed. Sulfuric acid acts as a stronger acid, protonating nitric acid to lose a water molecule and generate the nitronium ion, NO_2^+. This nitronium cation serves as the powerful active electrophile that attacks benzene.

(A) Mercury (as mercuric chloride)
(B) Cadmium (as cadmium sulfide)
(C) Vanadium (as vanadium pentoxide)
(D) Iron (as magnetic powder)

80. Group I cations in classical inorganic qualitative analysis consist of Pb^{2+}, Ag^{+}, and $Hg_2{}^{2}+$. What is the specific group reagent used to precipitate them out of an aqueous sample solution?
(A) Hydrogen sulfide gas in acidic medium
(B) Aqueous ammonium carbonate solution
(C) Dilute hydrochloric acid solution
(D) Aqueous ammonium hydroxide solution

81. In an electrolytic cell utilized in inorganic metal analysis, at which electrode does the process of reduction consistently occur?
(A) The positive anode
(B) The cathode
(C) The negative anode
(D) The salt bridge

82. Which of the following defines an endothermic reaction in chemical thermodynamics?
(A) A reaction that releases thermal energy into the environment
(B) A reaction that proceeds with a net increase in total mass
(C) A reaction where the free energy change (ΔG) is exactly zero
(D) A reaction where product enthalpy exceeds reactant enthalpy

83. The half-life of a first-order chemical reaction is calculated using standard kinetics equations. If the rate constant k is known, the formula for calculating the half-life ($t_{1/2}$) is:
(A) $t_{1/2} = 0.693 \ / \ k$
(B) $t_{1/2} = k \ / \ 0.693$
(C) $t_{1/2} = 1 \ / \ k$
(D) $t_{1/2} = 0.693 \times k$

84. Which non-metal, recognized by its distinct pungent odor resembling garlic, is frequently encountered in agricultural pesticide poisonings (such as Celphos/Aluminium phosphide)?
(A) Sulfur
(B) Chlorine
(C) Phosphorus
(D) Iodine

85. Plumbism is a term used in forensic pathology to describe chronic poisoning by which toxic s/p/d block element, historically found in paints and plumbing?
(A) Lead
(B) Cadmium
(C) Polonium
(D) Tin

86. Which chemical test is employed to ascertain the presence of peptide bonds in proteins, yielding a characteristic violet coloration upon addition of copper(II) sulfate in an alkaline solution?
(A) Benedict's test
(B) Iodine test
(C) Tollen's test
(D) Biuret test

87. Denaturation is a process that drastically alters the structure of a protein, often observed in forensic exhibits like coagulated blood. Denaturation disrupts all of the following structural levels of a protein EXCEPT the:
(A) Secondary structure
(B) Primary structure
(C) Tertiary structure
(D) Quaternary structure

88. A forensic scientist detects a specific organic compound that reacts rapidly with 2,4-Dinitrophenylhydrazine (Brady's reagent) to form a yellow-orange precipitate, but fails to react with Tollen's reagent. This compound is most likely a/an:
(A) Primary alcohol
(B) Carboxylic acid
(C) Ketone
(D) Aldehyde

89. Cyanide is a rapidly acting cellular asphyxiant that halts ATP production. In terms of inorganic coordination chemistry, cyanide is exceptionally toxic because the cyanide ion (CN-) acts as a strong:
(A) Strong Lewis acid that destabilizes cellular membrane lipids
(B) Potent oxidizing agent converting water to hydrogen peroxide
(C) Organic catalyst causing rapid systemic lipid saponification
(D) Strong ligand binding iron in cytochrome c oxidase

90. When distinguishing between 1°, 2°, and 3° alcohols in a suspected illicit liquor sample, the Lucas test is often employed. The Lucas reagent is a mixture of:
(A) Concentrated hydrochloric acid and

Downloaded from www.pdf.tube

anhydrous zinc chloride

(B) Concentrated sulfuric acid and aqueous potassium dichromate

(C) Ammoniacal silver nitrate solution with sodium hydroxide

(D) Elemental iodine in aqueous sodium hydroxide solution

www.nodia.in

NODIA

ANSWERS

1. (B) The identification and characterization of carbon-containing compounds such as drugs, poisons, and synthetic fibres
Organic chemistry focuses on the structure, properties, composition, reactions, and synthesis of carbon compounds. In forensic science, this discipline is primarily applied to identify, analyze, and characterize various organic materials encountered at crime scenes, including illicit drugs, toxicological poisons, fire accelerants, synthetic fibers, and explosives. These carbon substances form the primary foundation of physical evidence.

2. (D) Catenation
Catenation is the unique ability of carbon atoms to form stable covalent bonds with other carbon atoms, resulting in open chains, branched frameworks, or cyclic ring structures. This natural bonding property allows carbon to generate millions of complex organic molecules, including drugs, polymers, and biomolecules, which forensic scientists frequently encounter and analyze during criminal investigations.

3. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Carbon compounds exhibit tremendous structural diversity due to tetravalency and variable orbital hybridization. Carbon atoms form single, double, or triple bonds using sp^3, sp^2, and sp orbitals. This ability to form multiple bond types with carbon and other elements enables the existence of vast millions of distinct structural isomers and chemical functional groups in organic systems.

4. (C) Aromatic compounds
Aromatic compounds are cyclic unsaturated organic molecules characterized by fully conjugated planar rings that obey Huckel rule containing four n plus two pi electrons. Benzene represents the prototypical aromatic hydrocarbon structure. In arson cases, aromatic compounds such as benzene, toluene, and xylene are routinely identified as key chemical indicators of petroleum distillates and gasoline accelerants.

5. (A) P-2, Q-4, R-3, S-1
Standard IUPAC nomenclature rules assign specific characteristic suffixes to organic functional groups based on principal chemical functionality. Aldehydes are designated using the suffix al, whereas ketones utilize the suffix one. Alcohols carry the suffix ol to denote hydroxyl groups, and carboxylic acids are named with the suffix oic acid to denote terminal carboxyl groups.

6. (D) 2-Methylpropane
Isobutane is a branched alkane consisting of four carbon atoms and ten hydrogen atoms. According to systematic nomenclature guidelines, the longest continuous carbon chain contains three carbon atoms, forming the parent alkane propane. A methyl group substituent is attached to the second carbon atom, resulting in the correct systematic name two methylpropane for this compound.

7. (B) Functional isomerism
Functional isomerism occurs when organic compounds share the exact same molecular formula but possess entirely different functional groups in their chemical structures. Ethanol contains an alcohol functional group, whereas dimethyl ether contains an ether linkage. Despite both sharing the identical molecular formula C_2H_6O, their distinct functional groups grant them vastly different physical and chemical properties.

8. (A) I and II only
Enantiomers are stereoisomers that exist as non superimposable mirror images of one another. They exhibit optical activity, rotating the plane of polarized light in opposite directions by equal numerical magnitudes. However, enantiomers often display distinctly different biological, physiological, and pharmacological properties due to stereospecific interactions with chiral biological receptors, enzymes, and metabolic pathways within living organisms.

9. (D) Meso compound
A meso compound contains two or more chiral centers within its molecular structure but

Click Here to Buy book on Flipkart

(D) L2 mol-2 s-1

68. The minimum extra amount of energy absorbed by reactant molecules to form an activated complex is known as:
(A) Molecular kinetic energy
(B) Molecular potential energy
(C) Activation energy
(D) Threshold energy

69. According to thermochemical principles, a reaction that releases heat to its surroundings is classified as:
(A) Exothermic, with a negative ΔH
(B) Endothermic, with a positive ΔH
(C) Exothermic, with a positive ΔH
(D) Endothermic, with a negative ΔH

70. Hess's Law of Constant Heat Summation is a direct consequence of which fundamental scientific principle?
(A) Law of Conservation of Mass
(B) Second Law of Thermodynamics
(C) Le Chatelier's Principle
(D) First Law of Thermodynamics

71. White phosphorus, an inorganic non-metal often encountered in forensic investigations of incendiary devices and burns, must be stored under which substance to prevent spontaneous combustion?
(A) Kerosene
(B) Water
(C) Alcohol
(D) Liquid nitrogen

72. Which of the following analytical techniques is capable of performing simultaneous multi-element trace analysis with high sensitivity, making it highly preferred for profiling soil samples?
(A) Flame Photometry
(B) UV-Visible Spectrophotometry
(C) Inductively Coupled Plasma Mass Spectrometry (ICP-MS)
(D) Gas Chromatography with Flame Ionization Detection (GC-FID)

73. A bomb calorimeter is an apparatus frequently used to analyze the energetic content of flammable liquids or explosive residues. It specifically measures the heat of combustion at:
(A) Constant pressure
(B) Constant temperature
(C) Constant entropy
(D) Constant volume

74. For a chemical process to occur spontaneously under standard conditions of constant temperature and pressure, which thermodynamic state function must necessarily decrease?
(A) Gibbs free energy
(B) Enthalpy of the system
(C) Entropy of the system
(D) Internal system energy

75. In forensic toxicology, the elimination of a drug from the human body frequently follows first-order kinetics. This means that the rate of elimination is:
(A) Constant and independent of drug concentration
(B) Directly proportional to drug concentration
(C) Inversely proportional to drug concentration
(D) Proportional to the square of concentration

76. According to the Collision Theory of chemical kinetics, for a reaction to occur successfully, the colliding reactant molecules must possess:
(A) Only sufficient kinetic energy above average level
(B) Both threshold energy and proper orientation
(C) Only proper spatial orientation of molecules
(D) Neither orientation nor kinetic energy requirement

77. Which element belonging to the p-block is a highly toxic, shiny, grey solid semimetal that forms a hydride gas called stibine, historically tested alongside arsenic in forensic toxicology?
(A) Antimony
(B) Selenium
(C) Tellurium
(D) Bismuth

78. In the classic "Breathalyzer" test used by law enforcement to estimate blood alcohol content, ethanol is oxidized by potassium dichromate in sulfuric acid. The observable chemical change involves the orange dichromate ion being reduced to which color ion?
(A) Purple Mn^{2+}
(B) Blue Cu^{2+}
(C) Green Cr^{3+}
(D) Yellow Fe^{3+}

79. Which d-block element, in the form of its highly reactive powder, is frequently utilized as an efficient method for developing latent fingerprints on porous and non-porous surfaces?

NODIA

19. (B) I, II, and IV only
Carboxylic acids turn blue litmus paper red due to acidic hydrogen dissociation and release carbon dioxide gas upon reacting with sodium bicarbonate. The carbonyl carbon possesses sp^2 hybridization with planar geometry. Because carboxylic acids form stable hydrogen bonded dimers, their boiling points are significantly higher, not lower, than corresponding alcohols of comparable molecular weight.

20. (C) TNT
TNT, chemically known as 2,4,6-trinitrotoluene, is a high explosive prepared through the exhaustive nitration of toluene using a mixture of concentrated nitric acid and sulfuric acid. The three nitro groups attached to the aromatic ring provide oxygen for rapid intramolecular combustion, making TNT a stable yet powerful secondary explosive frequently encountered in forensic explosion evidence.

21. (A) Amide
When a carboxylic acid reacts with a primary or secondary amine under condensation conditions, water is eliminated to yield an amide functional group. In biochemistry and forensic protein chemistry, this specific linkage is called a peptide bond. Peptide bonds link sequential amino acid residues together to form the backbone structure of peptides and functional proteins.

22. (D) Furan
Furan is a five membered heterocyclic organic compound containing four carbon atoms and one oxygen atom within its aromatic ring structure. In contrast, pyridine contains a nitrogen atom in a six membered ring, pyrrole features a nitrogen atom in a five membered ring, and thiophene contains a sulfur atom incorporated into a five membered aromatic ring system.

23. (B) A basic, naturally occurring nitrogenous organic compound
Alkaloids are a large class of naturally occurring basic nitrogenous organic compounds mostly derived from plants. The presence of basic nitrogen atoms, typically within heterocyclic ring structures, imparts pronounced physiological and pharmacological activity in humans. Major alkaloids encountered in forensic evidence include morphine, codeine, cocaine, nicotine, strychnine, atropine, and quinine isolated from botanical plant sources.

24. (C) Wagner's reagent
Wagner reagent, composed of iodine dissolved in aqueous potassium iodide solution, is a standard general screening reagent in forensic chemistry for detecting alkaloids. Upon addition to alkaloid solutions, it reacts with the basic nitrogen centers to produce a characteristic reddish brown insoluble precipitate, confirming the presumptive presence of alkaloidal organic bases in unknown samples.

25. (A) P-3, Q-1, R-2, S-4
Morphine is a principal opiate alkaloid extracted directly from opium poppy seed pods. Quinine is an antimalarial alkaloid isolated from Cinchona tree bark. Nicotine is a natural toxic alkaloid present in high concentration within tobacco leaves. Cocaine is a potent tropane alkaloid stimulant extracted from the leaves of Erythroxylum coca plants.

26. (A) Tropane alkaloids
Cocaine chemically belongs to the class of tropane alkaloids, characterized by a bicyclic tropane ring skeleton in its molecular structure. Naturally produced by Erythroxylum coca, cocaine acts as a central nervous system stimulant and local anesthetic. Other common tropane alkaloids include atropine and scopolamine, which exhibit anticholinergic neurological activity in living organisms.

27. (A) I and II only
Pyridine is a six membered heterocyclic aromatic compound consisting of five carbon atoms and one sp^2 hybridized nitrogen atom. It follows Huckel rule with six pi electrons, conferring aromatic stability. The nitrogen atom retains an unshared lone pair of electrons residing in an sp^2 hybrid orbital orthogonal to the pi system, allowing basicity.

NODIA

28. (B) Adenine and Thymine
In double stranded DNA structure, nitrogenous bases follow specific complementary Watson Crick base pairing rules. Adenine is a bicyclic purine base that forms two hydrogen bonds selectively with thymine, which is a monocyclic pyrimidine base. Guanine, another purine, forms three hydrogen bonds with cytosine, a pyrimidine, ensuring equal base pairing distances.

29. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Pyrrole is significantly less basic than pyridine because the lone pair of electrons on the pyrrole nitrogen atom participates directly in the continuous six pi electron aromatic ring system. Protonating pyrrole disrupts aromaticity, making it energetically unfavorable. In pyridine, the lone pair occupies an sp^2 orbital outside the aromatic ring system entirely.

30. (C) C-4
Epimers are stereoisomers that differ in chemical configuration at only one specific chiral center while remaining identical across all other stereocenters. D-glucose and D-galactose represent key physiological hexose sugars that serve as classic C-4 epimers, differing exclusively in the spatial arrangement of the hydroxyl group and hydrogen atom at carbon number four.

31. (D) Disaccharide
Sucrose is classified chemically as a disaccharide carbohydrate because acid hydrolysis yields two monosaccharide units: one molecule of D-glucose and one molecule of D-fructose. These two monosaccharide units are joined together by an alpha 1,2 glycosidic bond between the anomeric carbons, rendering sucrose a non reducing disaccharide widely analyzed in food evidence.

32. (A) III, II, IV, I
Lassaigne test converts covalently bound elements into water soluble ionic sodium salts. First, the organic compound is fused with sodium metal inside a sealed ignition tube. Next, the red hot tube is plunged into distilled water inside a China dish. The mixture is filtered to yield sodium fusion extract, which is treated with ferrous sulfate and acid.

33. (B) The pH at which an amino acid has zero net electrical charge
The isoelectric point is the specific pH value at which an amino acid exists predominantly as a zwitterion, where the positive charge on the protonated amino group equals the negative charge on the carboxylate group. At this neutral net charge state, the amino acid exhibits no directional migration when subjected to an electric field during forensic electrophoresis.

34. (D) Alkaline hydrolysis of ester linkages
Saponification is the alkaline hydrolysis of ester linkages in triglycerides using strong bases such as sodium or potassium hydroxide, producing glycerol and carboxylate fatty acid salts. In post mortem forensic contexts, saponification of body adipose tissues under anaerobic, moist, alkaline conditions leads to adipocere formation, preserving human remains for forensic pathology examinations.

35. (A) Isoprene
Natural rubber is an addition polymer composed of repeated organic monomer units of isoprene, chemically designated as 2-methyl-1,3-butadiene. In natural rubber latex obtained from rubber trees, these isoprene units undergo enzymatic polymerization exclusively in a cis-1,4 configuration, providing high elasticity and flexibility required in automotive tires analyzed during forensic hit and run investigations.

36. (C) I, II, and IV only
Kevlar is a high strength synthetic aromatic polyamide used in body armor. Nylon-6,6 is a condensation copolymer produced from hexamethylenediamine and adipic acid. Polyvinyl chloride is an addition polymer widely applied in electrical insulation. Polystyrene is a synthetic aromatic addition polymer made from styrene monomers, not a natural polymer derived from cellulose.

37. (A) P-2, Q-1, R-4, S-3
Teflon is synthesized by polymerizing tetrafluoroethylene monomer units to yield polytetrafluoroethylene. Polypropylene is produced through addition polymerization of propene monomers. Orlon, or polyacrylonitrile, is generated from acrylonitrile monomers used in synthetic acrylic fibers. Polyvinyl chloride is synthesized from vinyl chloride monomers to form robust thermoplastic polymers present in forensic trace evidence.

38. (D) Complete inversion of configuration
A bimolecular nucleophilic substitution reaction proceeds through a concerted single step pathway without intermediate formation. The incoming nucleophile attacks the electrophilic carbon atom from the backside opposite to the leaving group. This backside attack forces the remaining substituents to flip position like an umbrella,

Downloaded from www.pdf.tube

resulting in complete inversion of stereochemical configuration, known as Walden inversion.

39. (B) Lithium aluminium hydride ($LiAlH_4$)
Lithium aluminium hydride is a powerful reducing agent widely used in organic chemistry synthesis. It effectively reduces carboxylic acids, esters, and acyl chlorides directly to primary alcohols by delivering hydride ions to carbonyl carbons. Weaker reducing agents like sodium borohydride fail to reduce carboxylic acids due to low reactivity toward unactivated carboxylates.

40. (C) Elimination reaction
Treating an alkyl halide with alcoholic potassium hydroxide promotes a beta elimination reaction, specifically a 1,2 dehydrohalogenation. The strong hydroxide base abstracts a proton from the beta carbon, causing the halide leaving group to detach from the alpha carbon. This concerted process generates a double bond, converting the saturated alkyl halide into an unsaturated alkene.

41. (D) A deep purple coloration
In Lassaigne test for detecting sulfur, fusion of the organic compound with sodium metal generates sodium sulfide. Adding aqueous sodium nitroprusside solution to this sodium fusion extract yields a distinctive deep purple or violet complex solution, confirming sulfur presence. This intense coloration results from the chemical formation of the thionitrosyl complex salt species.

42. (A) I < III < IV < II
Reactivity towards the bimolecular nucleophilic substitution mechanism depends primarily on steric hindrance surrounding the target electrophilic carbon. Methyl chloride experiences minimal steric crowding, reacting fastest. Primary alkyl halides like ethyl chloride react rapidly, followed by secondary halides like isopropyl chloride. Tertiary halides such as tertiary butyl chloride experience severe steric crowding, rendering them least reactive.

43. (B) Ferric thiocyanate
When an organic compound containing both nitrogen and sulfur undergoes sodium fusion in Lassaigne test, sodium thiocyanate is formed instead of separate sodium cyanide and sodium sulfide. Upon acidifying the sodium fusion extract and adding Iron(III) chloride solution, ferric thiocyanate complex is generated, yielding a blood red color solution that confirms dual element presence.

44. (B) To decompose interfering sodium cyanide and sodium sulfide
When testing for halogens using Lassaigne sodium fusion extract, interfering ions such as cyanide and sulfide must be completely eliminated. Boiling the extract with concentrated nitric acid decomposes sodium cyanide into volatile hydrogen cyanide gas and sodium sulfide into hydrogen sulfide gas. Removing these ions prevents false positive precipitates when adding silver nitrate reagent.

45. (A) Atomic radius
Moving from left to right across a period in the modern periodic table, the atomic radius generally decreases. This reduction occurs because effective nuclear charge increases as protons are added to the nucleus, while electrons enter the same principal energy shell. The stronger electrostatic attraction pulls the electron cloud closer to the nucleus, reducing atomic size.

46. (A) I and II only
Nitrogen possesses a higher first ionization enthalpy than oxygen due to its extra stable half filled 2p electronic configuration. Fluorine exhibits the highest electronegativity value on the Pauling scale across the periodic table. Noble gases have stable closed octet configurations, resulting in positive electron gain enthalpies rather than highly negative values because electron addition is unfavorable.

47. (D) Potassium – Characteristic lilac
Flame emission tests utilize characteristic spectral line emissions of alkali and alkaline earth metal salts in a Bunsen burner flame. Thermal energy excites valence electrons to higher levels, emitting light upon returning to ground state. Potassium compounds impart a distinct lilac flame color, whereas sodium yields yellow, barium gives apple green, and calcium gives brick red.

NODIA

48. (C) Heavy p-block elements (e.g., Pb, Bi)
The inert pair effect describes the reluctance of outermost s orbital electrons to participate in chemical bonding due to poor shielding by inner d and f subshells. This phenomenon is most prominently observed in heavier p-block

constant shares the identical concentration time units of mol L-1 s-1.

68. (C) Activation energy
Activation energy represents the minimum energy barrier that reacting molecules must absorb beyond their average ground state energy to form a short lived transition state or activated complex. This energy barrier must be overcome during molecular collisions for bonds to break and reform, governing the overall velocity and temperature dependence of chemical reaction rates.

69. (A) Exothermic, with a negative ΔH
According to classical thermochemical principles, an exothermic process releases thermal energy to its surroundings during chemical transformation. Because enthalpy of products is lower than enthalpy of reactants, the enthalpy change ΔH carries a negative sign. Conversely, endothermic reactions absorb heat energy from surroundings, resulting in positive enthalpy change values during chemical conversion.

70. (D) First Law of Thermodynamics
Hess Law of Constant Heat Summation states that overall enthalpy change for a chemical reaction is independent of reaction path or intermediate steps taken. This law derives directly from the First Law of Thermodynamics, establishing that energy cannot be created or destroyed. Because enthalpy is a thermodynamic state function, initial and final state energy values dictate net heat changes.

71. (B) Water
White phosphorus is a highly reactive inorganic allotrope that exhibits spontaneous chemiluminescence and combusts in air above 30 degrees Celsius, producing dense white phosphorus pentoxide smoke. To prevent spontaneous ignition upon atmospheric exposure, white phosphorus must be stored completely immersed under water, in which it is virtually insoluble and chemically unreactive under normal conditions.

72. (C) Inductively Coupled Plasma Mass Spectrometry (ICP-MS)
Inductively Coupled Plasma Mass Spectrometry combines high temperature argon plasma atomization with mass spectrometric detection. ICP-MS performs rapid multi-element trace analysis across ultratrace detection limits, providing precise elemental isotope ratio profiling. In forensic geology, ICP-MS is widely favored to characterize trace elemental signatures in soil evidence to establish geographical provenance.

73. (D) Constant volume
A bomb calorimeter consists of a rigid, sealed steel vessel immersed in a water jacket. Explosive residues or flammable liquids combust completely inside the sealed bomb under excess oxygen pressure. Because the heavy steel walls prevent expansion or volume changes during combustion, heat measured in a bomb calorimeter corresponds directly to internal energy change at constant volume.

74. (A) Gibbs free energy
Thermodynamic spontaneity under constant temperature and pressure conditions is governed by Gibbs free energy change, ΔG. A chemical process or physical transition occurs spontaneously only when Gibbs free energy decreases, yielding a negative ΔG value. When ΔG equals zero, the system reaches dynamic thermodynamic equilibrium, whereas a positive ΔG indicates a non spontaneous chemical process.

75. (B) Directly proportional to drug concentration
First order pharmacokinetics implies that rate of drug elimination from blood plasma is directly proportional to current systemic drug concentration. Consequently, a constant percentage or fraction of drug is eliminated per unit time. In forensic toxicology, first order elimination allows back calculation of drug doses, contrasting with zero order clearance where elimination proceeds at a constant rate.

76. (B) Both threshold energy and proper orientation
Collision theory posits that chemical reaction velocity depends on collision frequency among reactant molecules. However, for collisions to successfully transform reactants into reaction products, colliding molecules must simultaneously possess energy equal to or exceeding threshold activation energy barrier, and collide in a proper spatial orientation that allows targeted chemical bonds to break and reform efficiently.

77. (A) Antimony
Antimony is a toxic p-block semimetal exhibiting lustrous grey solid elemental form. In classical

Click Here to Buy book on Amazon

58. (A) Lead, Barium, Antimony
Gunshot residue particles generated during firearm discharge originate primarily from primer mixture combustion. The classic chemical formulation of gunshot primer contains lead styphnate as an initiator, barium nitrate as an oxidizing agent, and antimony sulfide as fuel. Detecting characteristic spherical particles containing lead, barium, and antimony confirms gunshot residue presence in forensic firearms analysis.

59. (B) Severe alopecia (hair loss)
Thallium is an extremely toxic heavy metal that was historically incorporated into rodenticides and homicidal poisonings. Thallium cations substitute for potassium ions in physiological sodium potassium ATPase pumps, disrupting cellular ion transport and protein synthesis. A pathognomonic diagnostic feature of chronic or subacute thallium toxicity is severe alopecia, characterized by rapid widespread hair loss.

60. (B) Common ion effect suppresses H_2S ionization
In inorganic wet qualitative scheme, Group II cations are selectively precipitated as insoluble sulfide salts. Acidifying the sample solution with dilute hydrochloric acid introduces excess hydronium ions. By common ion effect, this suppresses the reversible ionization equilibrium of dissolved hydrogen sulfide gas, decreasing sulfide ion concentration so that only Group II cations exceed solubility products.

61. (A) Fresh $FeSO_4$ solution and concentrated H_2SO_4
The confirmatory brown ring test for nitrate ions involves mixing aqueous sample extract with freshly prepared ferrous sulfate solution, followed by slowly pouring concentrated sulfuric acid along the container wall. Sulfuric acid reduces nitrate to nitric oxide, which reacts with hydrated ferrous ions to form a characteristic brown complex ring at the liquid junction.

62. (C) The Beer-Lambert Law
Atomic Absorption Spectroscopy measures elemental concentrations by vaporizing sample cations into ground state free atoms in a flame or furnace. These ground state atoms absorb resonance light of specific characteristic wavelengths emitted by an element specific source lamp. Quantitative analysis relies directly on the Beer-Lambert Law, relating measured absorbance linearly to atomic concentration.

63. (D) Hollow cathode lamp
In Atomic Absorption Spectroscopy, a hollow cathode lamp is the standard light source used to produce narrow line emission spectrum corresponding precisely to atomic absorption lines of the target analyte element. The cathode contains the analyte metal, emitting elemental spectral emission lines that ground state atoms in the atomic vapor absorb with high selectivity.

64. (C) III only
Rules for assigning oxidation numbers state that uncombined neutral elements possess an oxidation state of zero, and oxygen typically exhibits minus two in standard inorganic compounds except peroxides and fluorides. However, the algebraic sum of oxidation states for all constituent atoms in a polyatomic ion equals the overall charge of the ion, not zero.

65. (B) Argon
Inductively Coupled Plasma Optical Emission Spectroscopy utilizes argon gas passed through a quartz torch surrounded by an induction coil. Radiofrequency energy ionizes the argon gas stream, forming a stable high temperature plasma reaching temperatures of 6,000 to 10,000 Kelvin. This extreme thermal energy atomizes and excites trace elemental species in forensic glass samples.

66. (D) Chemical Kinetics
Chemical kinetics is the branch of physical chemistry concerned with measuring reaction rates, investigating factors affecting chemical reaction velocities, and elucidating step by step reaction mechanisms. In contrast, thermodynamics determines reaction feasibility and equilibrium position, surface chemistry studies interface phenomena, and electrochemistry examines chemical energy conversions involving electrical potential and ion charge transfers.

NODIA

67. (A) mol L-1 s-1
In a zero order chemical reaction, the rate of reaction is entirely independent of reactant concentration. Expressing reaction rate as change in concentration over time yields units of moles per liter per second. Since rate equals rate constant k for zero order kinetics, the rate

87. (B) Primary structure
Protein denaturation involves structural disruption caused by thermal heat, extreme pH, or chemical denaturants. Denaturation unfolds protein native states, breaking non-covalent interactions like hydrogen bonds, ionic bridges, and hydrophobic interactions responsible for secondary, tertiary, and quaternary structures. However, robust covalent peptide bonds forming primary amino acid sequence remain intact throughout denaturation processes.

88. (C) Ketone
Reaction with 2,4-dinitrophenylhydrazine (Brady reagent) forms yellow-orange hydrazone precipitates, confirming presence of carbonyl functional groups present in both aldehydes and ketones. However, aldehydes undergo oxidation with Tollen reagent to produce silver mirrors, whereas ketones resist mild oxidation. Consequently, a compound reacting with Brady reagent while remaining negative with Tollen reagent is a ketone.

89. (D) Strong ligand binding iron in cytochrome c oxidase
In toxicological and coordination chemistry mechanisms, cyanide ion CN- acts as a strong field ligand. Cyanide binds with extremely high affinity to iron(III) cations within active sites of cytochrome c oxidase in mitochondrial electron transport chains. This strong ligand coordination halts cellular aerobic respiration, preventing cellular ATP synthesis and causing rapid systemic cellular asphyxiation.

90. (A) Concentrated hydrochloric acid and anhydrous zinc chloride
Lucas reagent is prepared by mixing concentrated hydrochloric acid and anhydrous zinc chloride catalyst. Used to distinguish primary, secondary, and tertiary alcohols, Lucas test relies on nucleophilic conversion of alcohols into insoluble alkyl chlorides. Tertiary alcohols react immediately forming turbid oil layers, secondary alcohols react within five minutes, while primary alcohols produce no turbidity at room temperature.

Downloaded from www.pdf.tube

forensic toxicology, antimony compounds undergo chemical reduction in acidic media containing zinc metal to form stibine gas, SbH3. Like Marsh test for arsenic, stibine gas decomposes upon thermal heating to deposit metallic antimony mirrors, allowing forensic detection in suspected heavy metal poisonings.

78. (C) Green Cr^{3+}
In chemical breathalyzer devices, breath ethanol vapor reacts with acidic potassium dichromate solution. Ethanol is oxidized to acetic acid, while orange dichromate anions containing hexavalent chromium Cr^{6+} are reduced to trivalent chromium Cr^{3+} cations. Trivalent chromium forms green chemical complexes in solution, enabling quantitative photometric determination of blood alcohol concentration based on color change intensity.

79. (D) Iron (as magnetic powder)
Finely divided iron particles form magnetic fingerprint powders used extensively in forensic crime scene investigation. Applied using a specialized magnetic wand, ferromagnetic iron microparticles adhere selectively to fatty lipid secretions and sebaceous residue transferred onto porous or non-porous surfaces by friction ridges, developing detailed latent fingerprint patterns without mechanical damage from traditional brushes.

80. (C) Dilute hydrochloric acid solution
In classical inorganic qualitative cation analysis, Group I cations lead, silver, and mercury(I) are separated from aqueous mixtures by precipitation as insoluble chlorides. Adding dilute hydrochloric acid solution as Group reagent provides chloride anions that exceed the low solubility product constants of $PbCl_2$, AgCl, and Hg_2Cl_2, forming solid white precipitates.

81. (B) The cathode
In electrochemical and electrolytic cells utilized for inorganic metal deposition and electroanalysis, reduction consistently occurs at the cathode electrode. Reduction is defined as electron gain or decrease in oxidation state. Cations present in electrolyte solutions migrate toward the cathode, where they accept incoming electrons from the external circuit to form neutral metallic deposits.

NODIA

82. (D) A reaction where product enthalpy exceeds reactant enthalpy
An endothermic reaction absorbs thermal energy from surrounding environments during chemical transformation. In physical thermodynamics, this process is characterized by product enthalpy exceeding reactant enthalpy, yielding a positive enthalpy change value, $\Delta H > 0$. Thermal energy input is stored within internal chemical bonds of formed products, lowering ambient system temperature.

83. (A) $t_{1/2} = 0.693 / k$
Integrated rate law equations for first order kinetics demonstrate that half life is independent of initial reactant concentration. Integrating the first order differential rate law yields the formula $t_{1/2} = \ln(2) / k$, where $\ln(2)$ equals approximately 0.693. Dividing 0.693 by first order rate constant k yields exact half life duration.

84. (C) Phosphorus
Phosphorus, specifically white phosphorus impurity present in agricultural pesticides like aluminium phosphide, releases phosphine gas upon contact with ambient moisture or gastric acid. Phosphine gas possesses a pungent odor resembling garlic or decaying fish. In forensic toxicology, detecting garlic odor during post mortem examination strongly indicates lethal phosphine or elemental phosphorus poisoning.

85. (A) Lead
Plumbism is the medical and forensic pathological term for chronic lead poisoning. Lead accumulates in bone, kidney, and brain tissues, inhibiting heme synthesis by inactivating delta aminolevulinic acid dehydratase and ferrochelatase enzymes. Chronic lead toxicity causes basophilic stippling in erythrocytes, abdominal colic, peripheral neuropathy, and characteristic blue lead lines on gingival margins.

86. (D) Biuret test
The Biuret test is a qualitative chemical reaction used in biochemical and forensic laboratories to detect peptide bonds in proteins. In alkaline media, copper(II) ions coordinate with nitrogen atoms of four adjacent peptide linkages in protein backbones, forming a violet complex. The color intensity directly correlates with total protein concentration in blood and body fluids.

(B) Switch or trigger mechanism
(C) Power source
(D) Main explosive charge

9. Which of the following defines the function of a detonator in an explosive train?
(A) It generates the main destructive high-pressure blast wave of the entire explosive device
(B) It creates a small shock wave to trigger the initiation of a secondary high explosive
(C) It chemically stabilizes the explosive mixture to delay spontaneous reaction indefinitely
(D) It absorbs ambient moisture and humidity to preserve and stabilize the primary charge

10. The blast wave generated by a high explosive detonation consists of two phases. What are they?
(A) A low-pressure positive phase followed by a high-pressure negative phase
(B) A high-pressure positive phase followed by a low-pressure negative phase
(C) A deflagration shock phase followed by a sustained thermal radiation phase
(D) An outward gas expansion phase followed by a rapid air condensation phase

11. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Secondary high explosives are relatively insensitive to heat, friction, and shock compared to primary explosives.
Reason (R): Secondary explosives require a severe initiating shock wave, usually provided by a detonator, to undergo detonation.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

12. When collecting post-blast explosive residues at a crime scene, which packaging material is considered most appropriate to prevent the loss of volatile evidence?
(A) Porous paper evidence bags sealed tightly with adhesive tape
(B) Standard single-layer flexible polyethylene plastic storage bags
(C) Clean, unlined metal paint cans or special nylon evidence bags
(D) Cardboard containers sealed completely with standard adhesive tape

13. The Griess test is a presumptive colour test commonly used in forensic laboratories to detect the presence of:
(A) Chlorates and perchlorates
(B) Sulphides and sulphates
(C) Carbonates and bicarbonates
(D) Nitrites and nitrates

14. Which reagent gives a characteristic red-violet colour when added to trinitrotoluene (TNT) during explosive residue analysis?
(A) Diphenylamine reagent dissolved in concentrated sulphuric acid
(B) Aqueous barium chloride reagent solution prepared in water
(C) Alcoholic potassium hydroxide (KOH) reagent solution
(D) Aqueous silver nitrate analytical testing solution

15. In thin-layer chromatography (TLC) of explosive residues, what is the most commonly used stationary phase?
(A) Cellulose
(B) Silica gel
(C) Alumina
(D) Polyamide

16. Consider the following statements regarding the instrumental analysis of explosives:
I. Gas Chromatography-Mass Spectrometry (GC-MS) is highly suitable for analyzing intact, thermally stable organic explosives.
II. Ion Chromatography (IC) is primarily used to detect inorganic ions such as chloride, nitrate, and sulphate in post-blast residues.
III. Liquid Chromatography-Mass Spectrometry (LC-MS) is preferred over GC-MS for thermally unstable explosives like HMX and PETN.
Which of the above statements is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

17. Ion Mobility Spectrometry (IMS) is a technology widely used in airports and field detection kits for explosives. On what principle does IMS primarily separate chemical compounds?
(A) Velocity of gas-phase ions moving through a

Click Here to Buy book on Flipkart

CHAPTER 21

Explosives, Petroleum Products and Arson Investigation

1. According to the principles of explosion chemistry, which of the following best defines deflagration?
(A) An exothermic reaction that propagates through unreacted material at a speed slower than the speed of sound
(B) A rapid chemical reaction that produces a shock wave traveling faster than the speed of sound
(C) A reaction that requires an external detonator to initiate the blast wave
(D) A phase change of a solid directly to a gas absorbing heat from the surroundings

2. Which of the following is classified as a primary explosive?
(A) Trinitrotoluene (TNT)
(B) Cyclotrimethylenetrinitramine (RDX)
(C) Lead azide
(D) Pentaerythritol tetranitrate (PETN)

3. What is the standard composition of traditional black powder used as a low explosive?
(A) 75 percent potassium nitrate, 15 percent charcoal, 10 percent sulphur
(B) 60 percent ammonium nitrate, 20 percent charcoal, 20 percent sulphur
(C) 75 percent potassium chlorate, 15 percent sulphur, 10 percent charcoal
(D) 50 percent potassium nitrate, 30 percent nitrocellulose, 20 percent sulphur

4. In explosive chemistry, which of the following statements about oxygen balance is correct?
(A) A positive oxygen balance indicates that the explosive lacks sufficient oxygen to fully oxidize its carbon and hydrogen
(B) Trinitrotoluene (TNT) has a positive oxygen balance
(C) Oxygen balance has no effect on the explosive power or detonation velocity
(D) A zero oxygen balance means the explosive contains exactly enough oxygen to completely oxidize all its combustible elements

5. The explosive compound commonly known as RDX (Research Department Explosive) is chemically named:
(A) 2,4,6-trinitrotoluene
(B) Cyclotrimethylenetrinitramine
(C) Pentaerythritol tetranitrate
(D) Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine

6. Match the explosive terminology in List I with its description in List II.
List I: Explosive Terminology
P. PETN
Q. HMX
R. Nitrocellulose
S. Ammonium Nitrate
List II: Description
1. Major component of single-base smokeless powder
2. Commonly mixed with fuel oil to form ANFO
3. Also known as Octogen
4. Often used as the core in detonating cords
(A) P-3, Q-4, R-2, S-1
(B) P-1, Q-2, R-3, S-4
(C) P-4, Q-3, R-1, S-2
(D) P-4, Q-1, R-3, S-2

7. What is the primary function of a plasticizer in a plastic explosive such as C-4?
(A) To significantly elevate the overall detonation velocity and brisance of the charge
(B) To supply the chemical mixture with essential oxygen required for complete combustion
(C) To substantially reduce the thermal melting threshold of the primary explosive component
(D) To serve as a binder, making the explosive flexible, malleable, and thermally stable

8. Which of the following is NOT a fundamental component of an Improvised Explosive Device (IED)?
(A) Taggant microchip

Downloaded from www.pdf.tube

elements like lead and bismuth, making lower oxidation states progressively more stable than higher group oxidation states.

49. (B) Diamond
Diamond is a naturally occurring crystalline allotrope of carbon where each carbon atom undergoes sp^3 hybridization, forming rigid tetrahedral covalent network lattices. This three dimensional framework grants diamond exceptional mechanical hardness, making it the hardest natural substance. Furthermore, diamond acts as an electrical insulator due to absent free electrons, while possessing exceptional thermal conductivity.

50. (D) Variable oxidation states and complex formation
Transition metals exhibit catalytic activity primarily due to partially filled d orbitals that allow variable oxidation states and the ability to form unstable intermediate coordination complexes with reactant molecules. This catalytic pathway lowers activation energy for chemical reactions by providing alternative reaction routes and bringing reactant molecules into favorable spatial orientations on catalyst surfaces.

51. (A) Chelating ligand
A chelating ligand is a polydentate electron donor molecule or ion that binds to a single central metal cation through two or more separate donor atoms simultaneously. This multiple attachment forms stable ring structures known as chelate rings. Chelation significantly enhances the thermodynamic stability of resulting coordination complexes compared to similar complexes formed by monodentate ligands.

52. (C) +2
In potassium hexacyanoferrate(II), $K_4[Fe(CN)_6]$, four potassium ions contribute a total charge of plus four, requiring the coordination complex anion $[Fe(CN)_6]^{4-}$ to possess a net charge of minus four. Each of the six cyanide ligands contributes a minus one charge. Solving the oxidation balance equation reveals that the central iron atom possesses an oxidation state of plus two.

53. (A) Na > Mg > Al > Si
Sodium, magnesium, aluminium, and silicon all belong to Period 3 of the periodic table. Across a period from left to right, atomic radii decrease progressively. This reduction occurs because increasing nuclear charge pulls electron shells closer to the nucleus. Consequently, sodium possesses the largest atomic radius, followed by magnesium, aluminium, and silicon.

54. (D) Disproportionation reaction
A disproportionation reaction is a specialized redox process wherein atoms of a single chemical element undergo both oxidation and reduction simultaneously within the same reaction. The reacting element increases its oxidation state in one chemical product while decreasing its oxidation state in another product. Standard examples include hydrogen peroxide decomposition and chlorine gas dissolving in basic solution.

55. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Most coordination complexes formed by transition metals exhibit distinct vivid colors due to d-d electronic transitions. In an octahedral ligand field, degenerate d orbitals split into two distinct energy sets. Absorbing specific wavelengths of visible light promotes unpaired electrons between these split d subshells. The remaining unabsorbed wavelengths are transmitted or reflected, producing observed complex colors.

56. (C) Arsenic
Arsenic is a notorious heavy metal poison historically termed inheritance powder due to its tastelessness, odorless nature, and delayed onset of symptoms mimicking natural illnesses. Chemically, arsenic toxicity stems from binding sulfhydryl groups on essential cellular enzymes, disrupting cellular respiration. The classical Marsh test relies on generating arsine gas to confirm microgram levels of arsenic in forensic organs.

NODIA

57. (A) I, II, and III only
Halogens in Group 17 exist naturally as nonpolar diatomic molecules. Iodine is a dark violet solid at room temperature that readily sublimes into gas upon mild heating. Astatine is a radioactive halogen element. Fluorine is the most electronegative element and exhibits exclusively a minus one oxidation state, lacking positive oxidation states due to absent d orbitals.

carrier gas under an electric field
(B) Deflection of molecular fragments based on mass-to-charge ratio in a high vacuum
(C) Differential absorption of specific characteristic wavelengths of infrared radiation
(D) Differential partitioning between a liquid mobile phase and a solid stationary phase

18. What are taggants in the context of commercial explosives?
(A) Chemical stabilizing additives incorporated to prevent thermal decomposition and premature detonation
(B) Chemical sensitizing agents utilized to significantly lower the activation energy of low explosives
(C) Microscopic markers added by manufacturers to aid in post-blast tracing and identification
(D) Synthetic polymer binders incorporated during manufacturing to stabilize plastic explosive formulations

19. Under the Explosive Substances Act, 1908, the term "explosive substance" is legally defined to include:\
(A) Materials for making explosives, and apparatus or machines intended to cause explosions
(B) Exclusively high-grade military and industrial chemical explosives such as TNT, PETN, and RDX
(C) Exclusively fully assembled, completed, and operational Improvised Explosive Devices (IEDs)
(D) Exclusively commercial blasting agents and explosives manufactured strictly for mining operations

20. Which of the following accurately describes a double-base smokeless powder?
(A) It consists solely of nitrocellulose
(B) It consists of nitrocellulose, nitroglycerin, and nitroguanidine
(C) It consists of potassium nitrate, charcoal, and sulphur
(D) It consists of a mixture of nitrocellulose and nitroglycerin

21. Which sequence represents the correct progressive order of an explosive train used to detonate a stable secondary high explosive?
(A) Main charge → Detonator → Booster
(B) Detonator → Booster → Main charge
(C) Booster → Main charge → Detonator
(D) Main charge → Booster → Detonator

22. In the context of initiating systems, how does a safety fuse differ primarily from a detonating cord?
(A) A safety fuse detonates at high supersonic speed, whereas a detonating cord deflagrates slowly over time
(B) A safety fuse strictly requires electrical initiation, whereas a detonating cord is initiated by open flame
(C) A safety fuse burns slowly at a set rate, while a detonating cord has an explosive core that detonates rapidly
(D) A safety fuse is extremely sensitive to friction, while a detonating cord is an impact-sensitive primary charge

23. Crude petroleum is separated into useful commercial fractions primarily based on which physical property during the refining process?
(A) Density
(B) Solubility
(C) Refractive Index
(D) Boiling point

24. Consider the following fraction products of petroleum distillation:
I. Kerosene
II. Refinery gases
III. Diesel oil
IV. Petrol (Gasoline)
Which of the following represents the correct arrangement of these fractions from lowest boiling point (top of column) to highest boiling point (bottom of column)?
(A) II, IV, I, III
(B) II, I, IV, III
(C) IV, II, I, III
(D) I, II, IV, III

25. The composition of commercial petrol (gasoline) typically consists of hydrocarbons with carbon chain lengths in the range of:
(A) C_1 to C_4
(B) C_5 to C_{12}
(C) C_{12} to C_{16}
(D) C_{20} to C_{30}

26. Which metric is standardly used to rate the ignition quality and delay period of diesel fuel?
(A) Octane number
(B) Cetane number

Click Here to Buy book on Amazon

(C) Viscosity index
(D) Flash point

27. What is the standard forensic and laboratory method used to detect the adulteration of petrol with kerosene?
(A) Gas Chromatography with Flame Ionization Detection (GC-FID)
(B) Ultraviolet-Visible Absorption Molecular Spectrophotometry
(C) High-Performance Atomic Absorption Spectrophotometry (AAS)
(D) Inductively Coupled Plasma Mass Spectrometry (ICP-MS)

28. To prevent the illegal diversion and adulteration of subsidized Public Distribution System (PDS) kerosene into automotive fuels, which marker dye is officially mandated?
(A) Phenolphthalein chemical indicator dye
(B) Sudan Red IV oil-soluble synthetic dye
(C) Alkyl anthraquinone blue marker dye
(D) Fluorescein sodium fluorescent dye

29. The viscosity index of a lubricating oil provides a measure of its:
(A) Chemical resistance to thermal oxidation at elevated engine operating temperatures
(B) Detergent capacity to dissolve sludge, carbon varnish, and hazardous engine deposits
(C) Autoignition temperature under extreme mechanical pressure and high thermal load
(D) Rate of change in kinematic viscosity with respect to temperature variations

30. A commercial lubricating grease is fundamentally defined as a solid or semi-solid product consisting of a dispersion of a thickening agent in a:
(A) High-density solid paraffin wax matrix
(B) Synthetic elastomer plasticizer medium
(C) Liquid petroleum or synthetic base oil
(D) Heavy bituminous asphalt binder resin

31. During the field detection of petrol adulteration with kerosene, a simple filter paper test is sometimes employed. A drop of unadulterated petrol placed on a piece of filter paper will:
(A) Leave a permanent dark yellow resinous stain on the paper matrix
(B) Evaporate completely, leaving no greasy stain or oily residue
(C) Leave a persistent translucent greasy spot on the paper matrix
(D) Turn the filter paper to a distinct blue color upon drying

32. From a chemical perspective, what kind of reaction is combustion?
(A) An endothermic reduction reaction
(B) An endothermic oxidation reaction
(C) An exothermic reduction reaction
(D) An exothermic oxidation reaction

33. The traditional "fire triangle" requires three essential components for a fire to start and sustain itself. These are:
(A) Heat, Fuel, Oxygen
(B) Heat, Fuel, Carbon dioxide
(C) Spark, Wood, Accelerant
(D) Oxygen, Nitrogen, Fuel

34. The "fire tetrahedron" adds a fourth crucial element to the fire triangle to fully explain the combustion process and the action of certain fire extinguishers. What is this fourth element?
(A) Surrounding atmospheric pressure conditions
(B) Flash point temperature threshold
(C) Uninhibited chemical chain reaction
(D) Thermal radiation energy transfer

NODIA

35. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): The fire point of a liquid is always a few degrees higher than its flash point.
Reason (R): At the flash point, enough vapour is produced to ignite momentarily, but the evaporation rate is insufficient to sustain a continuous flame once the ignition source is removed.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

36. Which of the following defines the ignition temperature (autoignition temperature) of a substance?
(A) The minimum temperature at which a liquid evolves sufficient flammable vapour to ignite near its surface when exposed to a spark
(B) The theoretical maximum peak flame temperature attainable during the complete atmospheric combustion of the fuel mixture
(C) The equilibrium boiling temperature at which a liquid fuel rapidly vaporizes and

subsequently self-extinguishes in open air
(D) The lowest temperature required for a substance to ignite spontaneously in air without an external spark or flame

37. According to standard fire classification (such as IS 2190), a fire involving ordinary solid combustibles like wood, paper, and cloth is classified as:
(A) Class A
(B) Class B
(C) Class C
(D) Class D

38. A fire involving flammable liquids such as petrol, diesel, paints, and solvents is categorized as a:
(A) Class A fire
(B) Class B fire
(C) Class C fire
(D) Class D fire

39. In forensic fire investigation, what is an "accelerant"?
(A) A chemical additive incorporated into fire-fighting foam to accelerate flame suppression
(B) A cooling compound applied to rapidly lower the ambient temperature of a structure fire scene
(C) A portable electronic device used by investigators to detect unburnt hydrocarbon vapors
(D) Any flammable substance used to intentionally initiate or speed the spread of a fire

40. When evaluating burn patterns at a fire scene, what does a classic "V" pattern on a wall typically indicate to an investigator?
(A) The bottom apex of the "V" pattern generally points toward the fire's point of origin
(B) The fire was conclusively initiated through the deliberate pooling of a liquid accelerant
(C) The fire was caused by an high-voltage electrical short-circuit located near the ceiling
(D) The fire sustained peak combustion temperatures consistently exceeding 1000 degrees Celsius

41. At a suspected arson scene, investigators look for the "point of origin." Which physical characteristic is most often associated with the point of origin?
(A) The specific region exhibiting the least amount of heat damage and structural charring
(B) The area showing the deepest charring and lowest point of burn damage
(C) The highest elevated structural point relative to the surrounding room enclosure
(D) The exterior perimeter area where windows were completely shattered outward by pressure

42. Consider the following statements regarding indicators of arson:
I. Multiple, unconnected points of origin are a strong indicator of intentional fire setting.
II. The presence of a "trailer" (combustible material linking different fire seats) strongly suggests arson.
III. Complete incineration of a structure always indicates the use of an accelerant.
IV. "Pour patterns" on a floor with sharp lines of demarcation suggest an ignitable liquid was present.
Which of the above statements are correct?
(A) I, II, and III only
(B) I, II, and IV only
(C) II, III, and IV only
(D) I, III, and IV only

43. What does the term "spalling" refer to in the context of a fire scene examination?
(A) The cracking or chipping of concrete and masonry surfaces caused by intense heat
(B) The rapid thermal melting and fusion of synthetic textile fibers onto victim clothing
(C) The mechanical dismantling of wall structures during overhaul to locate hidden spot fires
(D) The gravitational pooling and accumulation of liquid accelerants in low-lying floor areas

44. What is the paramount, first-priority duty of the first responder arriving at a fire scene?
(A) Collecting volatile chemical samples and suspected accelerant residues immediately
(B) Taking detailed high-resolution photographs of all visible structural burn patterns
(C) Ensuring personal safety and medical care, then securing the scene
(D) Locating and interviewing potential suspects before they depart the immediate area

Downloaded from www.pdf.tube

18. (C) Microscopic markers added by manufacturers to aid in post-blast tracing and identification
Taggants are microscopic physical or chemical markers added to commercial explosive mixtures during production. These markers include color-coded multi-layered polymer chips, rare-earth element compounds, or isotope codes designed to withstand extreme blast pressures, allowing investigators to identify the commercial manufacturer, production lot batch, and legal distribution pathway of post-blast residues.

19. (A) Materials for making explosives, and apparatus or machines intended to cause explosions
The legal scope of the Explosive Substances Act of 1908 broadens prosecution boundaries beyond finished military or commercial blasting agents. It legally encompasses precursor materials utilized to manufacture explosives, partial assembly mixtures, fused housings, and any specialized mechanical apparatus or improvised devices intentionally constructed to initiate or aggravate damaging explosive blasts.

20. (D) It consists of a mixture of nitrocellulose and nitroglycerin
Double-base smokeless powders represent energetic propellant formulations containing two principal active explosive ingredients, namely fibrous nitrocellulose collodion and liquid nitroglycerin. Nitroglycerin acts as a plasticizer and energetic gelatinizing solvent for the nitrocellulose matrix, significantly increasing total energy output, overall flame temperature, and ballistic gas expansion rates compared to single-base powders.

21. (B) Detonator → Booster → Main charge
An explosive train organizes energetic materials in order of increasing mass and decreasing sensitivity to ensure safe, reliable detonation. A sensitive primer or detonator undergoes initial detonation, transferring its energetic shock wave to a moderately sensitive intermediate booster charge, which amplifies the shock power sufficiently to detonate the large, insensitive main high explosive charge.

22. (C) A safety fuse burns slowly at a set rate, while a detonating cord has an explosive core that detonates rapidly
A safety fuse comprises a black powder core wrapped in protective fabric that deflagrates continuously at a uniform, slow linear rate to provide a delayed flame. In contrast, a detonating cord contains a core of secondary high explosive, such as PETN, that detonates at supersonic speed to directly initiate attached charges.

23. (D) Boiling point
Petroleum refining separates crude oil into distinct commercial hydrocarbon fractions through continuous fractional distillation inside industrial distillation columns. This physical separation process depends entirely on differences in boiling points across constituent hydrocarbons, allowing lighter components with lower boiling points to vaporize and condense at higher levels while heavier fractions settle at lower column zones.

24. (A) II, IV, I, III
Fractional distillation of petroleum isolates hydrocarbon mixtures along a temperature gradient according to boiling point ranges. Low molecular weight refinery gases exit at the top with the lowest boiling points below twenty degrees Celsius, followed progressively by petrol, kerosene, and diesel oil, which possesses the highest boiling range among these fractions near the column base.

25. (B) C_5 to C_{12}
Automotive petrol, or gasoline, is a complex mixture of volatile aliphatic and aromatic liquid hydrocarbons obtained from petroleum distillation. The carbon chain distribution for constituent molecules in commercial petrol blends ranges predominantly from five to twelve carbon atoms, corresponding to a boiling range between thirty and two hundred degrees Celsius at atmospheric pressure.

26. (B) Cetane number
The cetane number serves as a standard measure evaluating the combustion quality and ignition delay time of diesel fuel in compression-ignition engines. A higher cetane rating signifies a shorter time delay between fuel injection and autoignition, promoting smoother engine combustion, reduced mechanical knocking, easier cold starting performance, and overall lower unburned hydrocarbon emissions.

NODIA

evaporation

53. The presence of a "negative control" is essential in fire debris analysis. What constitutes a proper negative control in this context?
(A) An unused, clean sample container exposed to ambient laboratory air during testing procedures
(B) Unburned substrate material from the scene used to rule out background volatiles
(C) A pure reference sample of the suspected accelerant recovered directly from suspect custody
(D) An analytical blank consisting of pure chromatographic grade n-hexane injected into the GC-MS

54. Why are plastic bags strictly avoided for the packaging of fire debris evidence suspected to contain petroleum distillates?
(A) They undergo exothermic chemical reactions when contacting hot charred wood debris
(B) They are highly susceptible to mechanical tearing, degradation, and puncture by sharp structural debris
(C) They allow volatile vapours to escape and can leach interfering plasticizers into samples
(D) They thermally degrade and soften at standard room ambient temperature conditions

55. Consider the following statements regarding petroleum adulteration:
I. Mixing kerosene into diesel changes the cetane number and viscosity of the fuel.
II. Adulteration of petrol with diesel is common because petrol is cheaper than diesel in India.
III. Gas Chromatography separates petroleum hydrocarbons primarily based on their boiling points and polarities.
Which of the above statements is/are correct?
(A) I and II only
(B) II and III only
(C) I, II, and III
(D) I and III only

56. Which of the following defines "spontaneous combustion"?
(A) Ignition of a substance caused by internal self-heating without an external spark or flame
(B) Ignition caused by an arc fault or electrical short circuit within a compromised household appliance
(C) The rapid combustion and vapor burn of a liquid accelerant when exposed to a direct open flame
(D) A fire initiated intentionally through the employment of a timed or delayed-action incendiary device

57. Linseed oil rags piled closely together in a poorly ventilated area are notoriously prone to causing a fire due to:
(A) Arson involving a timed chemical incendiary device
(B) Spontaneous combustion from oxidation
(C) Exceptionally high flash point fluid characteristics
(D) Sudden electrostatic discharge ignition

58. The phenomenon of "flashover" in structural fires is best described as:
(A) The initial high-energy electrical spark or pilot flame that ignites a pool of liquid accelerant
(B) Simultaneous ignition of all exposed combustible surfaces and gases in an enclosed area
(C) The sudden structural collapse of a heavily charred roof frame due to prolonged fire exposure
(D) The deep, localized burning occurring within the interior layers of a heavy structural timber beam

59. In the investigation of explosive incidents, which property determines the "shattering power" or brisance of a high explosive?
(A) The detonation velocity
(B) The flash point temperature
(C) The oxygen balance ratio
(D) The ambient storage temperature

60. What is the typical effect of a negative oxygen balance on an explosion?
(A) The explosive mixture fails to detonate or undergo sustained chemical reaction under any conditions
(B) The high-velocity detonation reaction generates excessive amounts of unreacted free oxygen gas
(C) The explosion forms toxic gases like carbon monoxide and soot due to incomplete oxidation
(D) The overall brisance and shattering potential of the chemical explosive is dramatically

Click Here to Buy book on Flipkart

(C) I, III, and IV only
(D) I, II, and III only

78. What makes a liquid explosive like nitroglycerin particularly dangerous compared to solid explosives like TNT?
(A) Nitroglycerin possesses a positive oxygen balance that destabilizes nearby chemical storage containers
(B) Nitroglycerin cannot under any circumstances undergo detonation without a direct electrical charge input
(C) It is unstable and extremely sensitive to mild physical shock
(D) Nitroglycerin rapidly absorbs ambient water vapor, causing the chemical compound to prematurely explode

79. When inspecting the broken edge of a glass pane fractured by fire (thermal stress), the investigator will typically observe:
(A) Radial and concentric fractures with distinct hackle marks indicating mechanical impact
(B) Wavy, meandering crack lines with smooth edges and no significant hackle marks
(C) A perfectly straight line fracture down the center
(D) Pulverization of the glass into microscopic powder

80. The presence of melted aluminum components (such as window frames) at a fire scene generally indicates that the fire temperatures exceeded:
(A) 200 degrees Celsius
(B) 660 degrees Celsius
(C) 1500 degrees Celsius
(D) 2500 degrees Celsius

81. Which instrument is often used by explosive detection dogs (canine units) as their biological equivalent?
(A) Explosive Vapor Detector (EVD)
(B) Ultraviolet-Visible Absorption Spectrometer
(C) High-Resolution Gas Chromatograph Instrument
(D) Powder X-ray Diffractometer System

82. Match the instrumental technique in List I with its primary application in forensic chemistry in List II.
List I: Instrumental Technique
P. Ion Chromatography (IC)
Q. Gas Chromatography-Mass Spectrometry (GC-MS)
R. Thin Layer Chromatography (TLC)
S. Raman Spectroscopy
List II: Primary Application
1. Rapid, non-destructive laser-based identification of suspect bulk powders
2. Detailed profiling of complex organic liquid accelerant mixtures
3. Quantitative detection of inorganic ions (nitrates, chlorates) in post-blast extracts
4. Quick, low-cost presumptive separation of explosive mixtures on a coated plate
(A) P-2, Q-3, R-1, S-4
(B) P-3, Q-4, R-2, S-1
(C) P-3, Q-2, R-4, S-1
(D) P-1, Q-2, R-4, S-3

83. Why is nitrocellulose often described as having different grades (e.g., guncotton vs. collodion)?
(A) Based on its nitrogen content percentage
(B) Based on the specific amount of liquid nitroglycerin mixed into the matrix
(C) Based on the precise specific gravity and density of the chemical compound
(D) Based on the specific variety of charcoal precursor used in its synthesis

84. Which of the following represents the correct principle behind the working of a flame ionization detector (FID) commonly used to analyze petroleum products?
(A) It measures the intensity of ultraviolet light absorbed by chemical compounds exiting the column
(B) It fragments target molecules using an electron impact beam and separates them by mass-to-charge ratio
(C) It detects subtle heat capacity changes in the carrier gas stream as analytes pass through the cell
(D) It combusts hydrocarbons in a hydrogen flame to create ions measured as electric current

85. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Plastic explosives like C-4 are difficult to detect using standard airport X-ray and vapour screening techniques.
Reason (R): Plastic explosives have a very low vapour pressure and can be molded into irregular shapes that disguise their appearance.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.

NODIA

(C) The unknown sample is definitely a low explosive
(D) The solvent system used was incompatible with explosives

70. When investigating an arson incident involving an electrical appliance, what is the primary diagnostic sign that electrical arcing occurred prior to the fire rather than as a result of the fire melting the wires?
(A) Complete atmospheric oxidation of the copper wire structure leaving fine green ash
(B) Insulation completely burned away uniformally across the entire length of the conductor
(C) A smooth, rounded, re-solidified copper bead at a severed wire end
(D) The entire copper wire structure turning completely into brittle black carbon soot

71. The "Total Ion Chromatogram" (TIC) is a standard output generated during which type of instrumental analysis for accelerants?
(A) Ion Chromatography
(B) Ultraviolet-Visible Spectroscopy
(C) High-Performance Liquid Chromatography (HPLC)
(D) Gas Chromatography-Mass Spectrometry

72. Ammonium nitrate (AN) is not easily detonated on its own. To create the explosive ANFO, it is intimately mixed with:
(A) Fuel oil (Diesel)
(B) Nitroglycerin
(C) Powdered aluminum
(D) Potassium chlorate

73. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Headspace GC-MS is the preferred technique for analyzing volatile accelerants in fire debris.
Reason (R): Headspace analysis extracts the volatile hydrocarbons without physically degrading the solid evidence or clogging the instrument with soot and tar.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

74. In petroleum chemistry, what does fractional distillation achieve?
(A) It chemically breaks down large heavy carbon chains into smaller hydrocarbon molecules using a catalyst
(B) It physically separates hydrocarbon mixtures based on boiling point differences
(C) It chemically removes organic sulfur impurities from raw crude oil feedstock using high-pressure hydrogen gas
(D) It catalytically polymerizes short-chain hydrocarbon gases into complex high-octane liquid fuels

75. Pyromania is considered a motive for arson. It is formally characterized as:
(A) An impulse-control disorder driven by an obsessive desire to set fires for gratification
(B) Deliberately setting a fire to conceal underlying primary crimes such as burglary or murder
(C) Deliberately setting a fire in a systematic fashion to fraudly claim insurance money
(D) Deliberately setting fires as an ideological act of political or socio-economic terrorism

76. In an explosive train, what role does a "booster" play?
(A) It provides the initial electrical firing current directly to the arming switch and safety fuse
(B) It supplies the high-temperature thermal spark required to ignite deflagrating black powder mixtures
(C) An intermediate explosive that amplifies shock from the detonator to ignite the main charge
(D) It chemically neutralizes or safely diffuses an armed explosive device upon remote command signal

NODIA

77. Consider the following statements regarding the Indian Explosive Substances Act, 1908:
I. The Act provides for punishment for causing explosions likely to endanger life or property.
II. Attempting to cause an explosion, even if it does not occur, is punishable under this Act.
III. Making or keeping explosives with intent to endanger life or property carries severe penalties.
IV. It only applies to military-grade explosives and excludes improvised devices.
Which of the above statements are correct?
(A) I, II, and IV only
(B) II, III, and IV only

increased

61. Consider the following steps involved in a post-blast scene investigation:
I. Collection of residues and debris for laboratory analysis
II. Securing the perimeter of the blast scene
III. Locating the seat of the explosion (crater)
IV. Triage and evacuation of casualties
Which of the following represents the correct sequential order of these steps?
(A) II, IV, I, III
(B) IV, III, II, I
(C) II, I, III, IV
(D) IV, II, III, I

62. Which class of explosive typically requires a heavily confined casing (like a pipe bomb) to produce a damaging blast effect?
(A) Primary high explosives compounds
(B) Secondary high explosive materials
(C) Low explosives
(D) Moldable plastic explosives

63. "Alligatoring" is a pattern observed during fire investigations. What does it describe?
(A) The pattern left by burning liquid accelerants flowing down a staircase
(B) The large, deep char blisters found on heavily burned wood
(C) The specific fracture pattern of tempered glass exposed to heat
(D) The melted residue of synthetic carpets

64. Under which Act is the unauthorized possession of a completed, functional improvised explosive device (IED) primarily prosecuted in India?
(A) The Arms Act, 1959
(B) The Petroleum Act, 1934
(C) The Environment (Protection) Act, 1986
(D) The Explosive Substances Act, 1908

65. The term "seat of explosion" at a bomb scene typically manifests physically as:
(A) A crater or localized area of intense fragmentation damage and soot
(B) A distinct, localized surface deposit of unburned propellent powder grains
(C) A prominent and distinct inverted "V" pattern recorded on an adjacent wall
(D) The specific physical zone containing the highest concentration of intact structural fragments

66. How does Gas Chromatography (GC) generally differentiate between an unweathered gasoline sample and a heavily weathered gasoline sample?
(A) The weathered sample shows a total absence of all detectable chromatographic hydrocarbon peaks
(B) The weathered sample shows a relative increase in low-boiling, early-eluting hydrocarbon peaks
(C) The weathered sample loses early-eluting, highly volatile hydrocarbon peaks
(D) The weathered sample chemical profile converts completely to aromatic organic compounds only

67. In forensic explosives analysis, the Griess test is heavily utilized. Which specific ion must be generated or present in the sample for the Griess reagent to form its characteristic pink/red azo dye?
(A) Nitrite ion
(B) Sulphate ion
(C) Ammonium ion
(D) Chloride ion

68. Consider the following steps of a fire scene investigation methodology following the scientific method:
I. Develop a hypothesis for the fire origin and cause
II. Test the hypothesis against all available evidence
III. Recognize the need to identify the origin and cause
IV. Collect data through scene observation and evidence gathering
Which of the following represents the correct order of these steps?
(A) III, I, IV, II
(B) IV, III, I, II
(C) I, IV, II, III
(D) III, IV, I, II

69. A forensic analyst subjects a piece of evidence to thin-layer chromatography (TLC). A reference standard of TNT and the unknown sample are spotted. After development and spraying with alcoholic KOH, both spots turn red-violet and travel to an Rf value of 0.65. What does this outcome suggest?
(A) The unknown sample conclusively contains RDX
(B) The unknown sample presumptively contains TNT

Downloaded from www.pdf.tube

(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

86. Which chemical test is standardly utilized in forensic laboratories to test for the presence of chlorate ions in a suspected low-explosive residue?
(A) Diphenylamine test
(B) Nessler's reagent test
(C) Aniline sulphate test
(D) Marquis test

87. Consider the following statements about lubricating oils and greases:
I. Lubricating oils are higher boiling fractions of petroleum than diesel.
II. Greases are made by adding a thickener, typically a metallic soap, to a lubricating fluid.
III. The viscosity index of a high-quality motor oil should be as low as possible to maintain performance under extreme heat.
Which of the above statements is/are correct?
(A) II and III only
(B) I and III only
(C) I, II, and III
(D) I and II only

88. Consider the following statements about marker dyes in petroleum products:
I. PDS kerosene is deliberately dyed to prevent its illegal use as fuel for diesel and petrol vehicles.
II. The standard dye used for this purpose in India is blue alkyl anthraquinone.
III. The dye can be chemically extracted and detected in the laboratory to prove adulteration.
IV. The presence of the blue dye increases the cetane number of kerosene to match diesel.
Which of the above statements are correct?
(A) I, II, and III only
(B) II, III, and IV only
(C) I, III, and IV only
(D) I, II, III, and IV

89. Match the explosive compound or residue in List I with its corresponding presumptive colour test reagent in List II.
List I: Explosive Compound or Residue
P. TNT
Q. Nitrites
R. Ammonium ion
S. RDX
List II: Presumptive Colour Test Reagent
1. Nessler's Reagent
2. Griess Reagent
3. Diphenylamine (after alkaline hydrolysis)
4. Alcoholic KOH
(A) P-3, Q-1, R-2, S-4
(B) P-4, Q-2, R-1, S-3
(C) P-4, Q-1, R-2, S-3
(D) P-2, Q-4, R-3, S-1

NODIA

90. Consider the following statements regarding the distinction between accidental electrical fires and intentional arson fires:
I. A melted copper wire with a blistered, porous surface usually indicates damage from the external heat of the fire.
II. A sharp, localized bead on a copper wire usually indicates primary electrical arcing prior to the fire.
III. The presence of liquid accelerant trace in unburned floorboards beneath a short-circuited appliance strongly suggests arson disguised as an electrical fire.
Which of the above statements are correct?
(A) I and II only
(B) I, II, and III
(C) II and III only
(D) I and III only

www.nodia.in

ANSWERS

1. (A) An exothermic reaction that propagates through unreacted material at a speed slower than the speed of sound
Deflagration is a rapid chemical reaction in which the combustion propagation rate remains subsonic relative to the unreacted substance. Energy transfer occurs primarily through thermal conduction and radiation rather than a supersonic shock wave. This process generates expanding gases at moderate pressures and is characteristic of low explosives like black powder used in propellants.

2. (C) Lead azide
Primary explosives are extremely sensitive chemical compounds that undergo rapid transition from deflagration to detonation when subjected to minimal mechanical friction, impact, spark, or heat. Lead azide functions as a classic primary explosive and is widely incorporated into detonators or blasting caps to initiate secondary explosives that are significantly less sensitive to external stimuli.

3. (A) 75 percent potassium nitrate, 15 percent charcoal, 10 percent sulphur
Traditional black powder is an inorganic low explosive formulation that relies on a specific stoichiometric mixture to sustain rapid subsonic combustion. Potassium nitrate acts as the oxidizing agent supplying oxygen, while charcoal provides carbon fuel and sulphur acts as a stabilizing fuel that lowers the ignition temperature, creating an energetic deflagrating chemical propellant mixture.

4. (D) A zero oxygen balance means the explosive contains exactly enough oxygen to completely oxidize all its combustible elements
Oxygen balance represents the degree to which an explosive compound contains sufficient internal oxygen to convert all carbon atoms to carbon dioxide, hydrogen to water, and metal components to oxides. Achieving zero oxygen balance optimizes explosive output, maximizing energy release and preventing the formation of toxic byproduct gases like carbon monoxide or unreacted soot particles.

5. (B) Cyclotrimethylenetrinitramine
Research Department Explosive, commonly known as RDX, is a powerful high explosive belonging to the nitramine chemical family. Its IUPAC systemic chemical designation is cyclotrimethylenetrinitramine or 1,3,5-trinitro-1,3,5-triazinane. This compound exhibits exceptional brisance and high detonation velocity, making it a critical component in military formulations like C-4 and modern secondary high explosive mixtures.

6. (C) P-4, Q-3, R-1, S-2
Explosive compounds possess distinct physical and operational applications across military and commercial domain sectors. Pentaerythritol tetranitrate forms the flexible core of high-velocity detonating cords. Cyclotetramethylene tetranitramine, known as Octogen or HMX, exhibits high thermal stability. Nitrocellulose serves as the energetic base in smokeless powders, while ammonium nitrate provides the oxidizer component when blended with fuel oil.

7. (D) To serve as a binder, making the explosive flexible, malleable, and thermally stable
Plasticizers incorporated into plastic explosives like C-4 bind crystalline high explosive grains, such as RDX, into a cohesive polymer matrix. This additive imparts pliability and hand-moldability, allowing the explosive charge to be shaped for directed demolition tasks while simultaneously lowering sensitivity to accidental mechanical impacts and enhancing chemical stability across varying temperature ranges.

8. (A) Taggant microchip
An Improvised Explosive Device relies on four core functional elements, commonly summarized by the acronym PIES: a Power source, an Initiator or detonator, Main explosive charge, and a Switch or triggering mechanism. Taggant microchips are tracing markers optionally added during commercial manufacturing and do not constitute a functional component required to construct an improvised explosive device.

Click Here to Buy book on Amazon

9. (B) It creates a small shock wave to trigger the initiation of a secondary high explosive
A detonator is a primary initiation device containing sensitive explosive material that converts a thermal, mechanical, or electrical pulse into a high-velocity localized shock wave. This initial shock wave provides the required activation energy to detonate relatively insensitive secondary high explosives, serving as a critical bridge within an overall explosive firing sequence or train.

10. (B) A high-pressure positive phase followed by a low-pressure negative phase
High explosive detonations produce a blast wave characterized by two sequential pressure regimes. The initial positive phase consists of a rapid shock front that compresses surrounding air and delivers sharp overpressure forces. As gases expand outward past equilibrium, it creates a trailing negative phase defined by a partial vacuum that pulls air back inward.

11. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Secondary high explosives possess low chemical sensitivity to external mechanical friction, thermal heat, and minor physical shocks, preventing accidental ignition during routine handling. Because of this inherent stability, they require a high-energy supersonic shock wave generated by an primary initiating charge, such as a detonator, to achieve complete chemical detonation throughout the material.

12. (C) Clean, unlined metal paint cans or special nylon evidence bags
Post-blast evidence often contains low concentrations of volatile explosive compounds or accelerants that readily diffuse through standard porous paper or thin plastic packaging. Clean, unlined metal paint cans and specialized vapor-impermeable nylon bags form airtight seals that effectively prevent chemical loss through evaporation, volatile cross-contamination, or degradation prior to analytical testing.

13. (D) Nitrites and nitrates
The Griess test is a colorimetric assay used in forensic chemistry to detect inorganic nitrites and nitrates, which are common combustion products of inorganic explosives and propellants like black powder and smokeless powder. Nitrates are reduced to nitrites, reacting with sulfanilic acid and alpha-naphthylamine to form a characteristic magenta-pink azo dye.

14. (C) Alcoholic potassium hydroxide (KOH) reagent solution
Aqueous or alcoholic potassium hydroxide serves as a chemical spot-test reagent for polynitro aromatic explosives like trinitrotoluene. Alkaline hydrolysis removes nitro groups or forms Janovsky-type electron-donor complexes with the aromatic ring structure of TNT, generating a distinctive red-violet or purplish-colored Meisenheimer salt product that confirms the presumptive presence of nitroaromatics.

15. (B) Silica gel
Silica gel is the standard stationary phase utilized in normal-phase thin-layer chromatography for screening post-blast explosive residues. Its polar surface structure facilitates clear chromatographic separation of nitroaromatic, nitramine, and nitrate ester organic explosive compounds when combined with appropriate organic solvent mobile phases, providing reproducible retardation factor values during preliminary qualitative screening.

16. (D) I, II, and III
Analytical protocols for explosives utilize complementary instrumental methods based on chemical properties. Gas chromatography-mass spectrometry effectively isolates thermally stable organic compounds. Ion chromatography accurately quantifies inorganic post-blast ions such as nitrates and sulphates. Liquid chromatography-mass spectrometry provides liquid-phase separation that prevents thermal degradation of heatsensitive high explosives like HMX and PETN.

17. (A) Velocity of gas-phase ions moving through a carrier gas under an electric field
Ion Mobility Spectrometry separates gas-phase ionized molecules according to their drift velocities through an opposing buffer gas stream under an applied electric field. Ion separation depends on molecular mass, charge, and collision cross-sectional geometry, enabling rapid millisecond field screening of microscopic trace explosive vapors in security screening environments like airport checkpoints.

NODIA

45. What is the standard prescribed container for collecting fire debris suspected of containing volatile ignitable liquids?
(A) Heavy-duty polyethylene plastic bags sealed with heavy tape
(B) Corrugated cardboard boxes internally lined with filter paper
(C) Ordinary multi-ply brown paper evidence collection bags
(D) Clean, unlined metal paint cans with airtight lids

46. In the forensic laboratory, "headspace analysis" is a common technique used for fire debris. What is the fundamental principle of this method?
(A) Dissolving collected fire debris in an organic solvent and injecting the extracted liquid phase into a gas chromatograph
(B) Examining structural fire debris under a high-power optical stereomicroscope to identify unburned liquid accelerant droplets
(C) Heating the sealed container to vaporize volatile accelerants into the air above the sample for analysis
(D) Measuring the precise gravimetric change in total mass of the recovered debris sample after controlled laboratory ignition

47. Solid Phase Microextraction (SPME) is an advanced technique for arson debris analysis. What does the SPME fiber do?
(A) It chemically bonds to the solid debris substrate to prevent the loss of volatile organic vapours during collection
(B) It adsorbs headspace volatile organics onto its coating for thermal desorption in a gas chromatograph
(C) It serves as a selective stationary phase medium for initial separation during thin-layer chromatography
(D) It selectively filters out interfering atmospheric carbon monoxide and carbon dioxide from the sample vapor

48. During GC-MS analysis of fire debris, finding an intact homologous series of n-alkanes ranging from roughly C8 to C_15 strongly indicates the presence of which common accelerant?
(A) Gasoline (Petrol)
(B) Methanol
(C) Acetone
(D) Kerosene

49. When distinguishing an electrical fire from arson, an investigator notes "beading" on copper wires. A bead caused by an electrical short circuit typically appears:
(A) Sharp, well-defined, and localized at the point of arcing
(B) Blistered, porous, and covering a long length of the wire
(C) Blackened and heavily oxidized without any melting
(D) Completely dissolved into the surrounding insulation

50. Match the classification of fire in List I with the most appropriate extinguishing agent in List II.
List I: Classification of Fire
P. Class A (Wood, Paper)
Q. Class B (Flammable Liquids)
R. Class C (Flammable Gases)
S. Class D (Combustible Metals)
List II: Extinguishing Agent
1. Dry powder (Specialized metal agents)
2. Water
3. Foam or Dry Chemical Powder
4. Carbon dioxide or Dry Chemical Powder
(A) P-3, Q-2, R-1, S-4
(B) P-1, Q-4, R-3, S-2
(C) P-2, Q-3, R-4, S-1
(D) P-2, Q-4, R-3, S-1

51. Which post-fire phenomenon describes the explosive ignition of superheated, oxygen-deprived combustible gases when an influx of fresh oxygen is suddenly introduced into a burning compartment?
(A) Backdraft
(B) Flashover
(C) Deflagration
(D) Spontaneous combustion

52. What does "weathering" mean in the context of forensic analysis of petroleum accelerants recovered from a fire scene?
(A) The physical weathering and breakdown of charred structural wood by high-pressure water hoses during fire suppression
(B) The biological contamination of post-fire debris samples caused by soil microorganisms during extended outdoor exposure
(C) The chemical transformation of a liquid petroleum accelerant into an unstable high explosive compound under severe heat
(D) The preferential loss of lighter, volatile hydrocarbon fractions due to heat or

Downloaded from www.pdf.tube

27. (A) Gas Chromatography with Flame Ionization Detection (GC-FID)
Gas Chromatography coupled with Flame Ionization Detection is the authoritative laboratory method for detecting petroleum adulteration. By separating volatile and semi-volatile hydrocarbons according to boiling points, GC-FID produces high-resolution chromatographic profiles that reveal characteristic kerosene hydrocarbon peaks, such as n-alkanes ranging from C_9 to C_{16}, when blended into commercial petrol matrix samples.

28. (C) Alkyl anthraquinone blue marker dye
In India, subsidized Public Distribution System kerosene is mandated to be chemically dyed with blue alkyl anthraquinone. This distinct dye colors the fuel for immediate visual identification and allows laboratory detection via spectrophotometry or thin-layer chromatography, preventing illegal diversion and blending of subsidized kerosene into commercial automotive fuels like petrol or diesel.

29. (D) Rate of change in kinematic viscosity with respect to temperature variations
The viscosity index is an empirical parameter describing how the kinematic viscosity of a lubricating oil alters with temperature changes. A high viscosity index indicates minimal thinning at elevated operating temperatures and lower thickening in cold environments, ensuring stable fluid film lubrication and mechanical protection across wide temperature operating ranges in internal combustion engines.

30. (C) Liquid petroleum or synthetic base oil
Lubricating greases are semi-solid structured lubricants produced by dispersing a thickening agent, such as lithium or calcium metallic soaps, within a liquid base oil. The liquid petroleum or synthetic base oil accounts for the majority of the formulation and provides essential friction-reducing film properties, while the thickener matrix retains the fluid in position.

31. (B) Evaporate completely, leaving no greasy stain or oily residue
Pure, unadulterated petrol consists entirely of light, highly volatile hydrocarbons with low boiling points that evaporate rapidly at room temperature. When a spot of pure petrol is applied to standard filter paper, it completely volatilizes within a short duration, leaving no permanent translucent stain, greasy spot, or heavy petroleum residue behind on the paper.

32. (D) An exothermic oxidation reaction
Combustion is chemically defined as an exothermic oxidation reaction occurring between a chemical fuel and an oxidizing agent, typically atmospheric oxygen. This chemical transformation breaks covalent bonds in fuel molecules, rapidly forming oxides like carbon dioxide and water vapor while releasing substantial amounts of thermal heat and visible light energy into the surrounding environment.

33. (A) Heat, Fuel, Oxygen
The classic fire triangle model illustrates the three fundamental components required to initiate and sustain flaming combustion. Fuel supplies the oxidizable material, oxygen acts as the essential oxidizing agent, and thermal heat raises the fuel to its ignition temperature. Removing any single component immediately starves the combustion process and extinguishes the fire.

34. (C) Uninhibited chemical chain reaction
The fire tetrahedron expands the traditional three-sided fire triangle by incorporating an uninhibited self-sustaining chemical chain reaction as its fourth critical side. Free radical reactions involving hydroxyl and hydrogen intermediates maintain flaming combustion in gas phases, explaining how clean chemical suppressing agents, like Halon substitutes, extinguish fires chemically without primary cooling or smothering effects.

NODIA

35. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
At the flash point, a liquid fuel produces sufficient vapour to momentarily ignite in the presence of an ignition source, but the vaporization rate cannot sustain continuous combustion. Heating the liquid a few degrees higher reaches the fire point, where vapor generation is fast enough to support continuous flaming combustion for at least five seconds.

36. (D) The lowest temperature required for a substance to ignite spontaneously in air without an external spark or flame
The autoignition temperature represents the lowest thermal threshold at which a combustible substance absorbs sufficient ambient thermal energy to undergo self-heating and spontaneous

55. (D) I and III only
Adulterating diesel with kerosene alters physical fuel properties by reducing overall kinematic viscosity and depressing cetane ratings. Gas chromatography effectively separates hydrocarbon components within fuel matrices based on boiling points and chemical polarities. In India, petrol is consistently more expensive than diesel, making petrol-diesel adulteration economically unviable compared to kerosene-diesel blending.

56. (A) Ignition of a substance caused by internal self-heating without an external spark or flame
Spontaneous combustion occurs when an exothermic chemical reaction, such as slow atmospheric oxidation inside a porous organic material, generates heat faster than it dissipates. As internal temperatures accumulate, the material reaches its autoignition point, triggering spontaneous flaming combustion without exposure to any external spark, flame, or direct thermal ignition source.

57. (B) Spontaneous combustion from oxidation
Linseed oil contains high concentrations of unsaturated fatty acids that undergo exothermic oxidation when exposed to atmospheric oxygen. When oil-soaked rags are tightly piled in poorly ventilated spaces, generated thermal heat cannot dissipate into surrounding air. The accumulating heat accelerates oxidation rates until internal temperatures reach autoignition, inducing spontaneous combustion.

58. (B) Simultaneous ignition of all exposed combustible surfaces and gases in an enclosed area
Flashover represents a critical transition phase during an compartment fire where radiant heat transfer from accumulated hot ceiling gas layers rapidly heats all exposed combustible surfaces. Upon reaching autoignition temperatures, all exposed combustible materials and pyrolyzed gases within the enclosure ignite near-simultaneously, transitioning the localized fire into a full room involvement.

59. (A) The detonation velocity
Brisance describes the localized shattering or fragmenting power exerted by a high explosive upon surrounding materials. This destructive capability depends primarily on detonation velocity and rapid high-pressure shock wave development. High detonation velocities produce sharp pressure rises at the reaction front, maximizing shock transfer and fracturing surrounding steel, concrete, or structural casings.

60. (C) The explosion forms toxic gases like carbon monoxide and soot due to incomplete oxidation
A negative oxygen balance indicates that an explosive formulation lacks sufficient internal oxygen atoms to fully oxidize all constituent carbon and hydrogen elements into carbon dioxide and water. Consequently, detonation reactions under negative oxygen conditions produce incomplete combustion products, liberating toxic carbon monoxide gas, hydrogen gas, and unreacted elemental carbon soot.

61. (D) IV, II, III, I
Post-blast field investigations follow a strict operational hierarchy. First priority involves life safety through casualty triage and medical evacuation. Investigators then establish secure scene perimeters to prevent evidence disturbance. Next, personnel locate the seat of explosion or crater to identify reaction dynamics, followed by systematic collection of post-blast chemical residues and fragmentation debris.

62. (C) Low explosives
Low explosives undergo subsonic deflagration rather than supersonic detonation. Unconfined low explosives burn rapidly without producing high destructive pressure waves. To generate destructive blast forces or structural rupture, low explosive formulations like black powder or smokeless powder require heavy physical confinement, such as a sealed steel pipe, to trap rapidly expanding gas products until container failure occurs.

63. (B) The large, deep char blisters found on heavily burned wood
Alligatoring describes a distinctive visual fire damage pattern formed on burned wood structural surfaces, characterized by coarse, deep, rounded char blisters resembling alligator hide. Large, shiny, deep char blisters generally indicate rapid, intense heating or prolonged thermal exposure, assisting fire investigators during structural burn pattern evaluations and origin point assessments.

Click Here to Buy book on Flipkart

46. (C) Heating the sealed container to vaporize volatile accelerants into the air above the sample for analysis
Headspace sampling isolates volatile ignitable liquid residues from fire debris without physical solvent extraction. The sealed metal container is heated, causing volatile hydrocarbons trapped within substrate matrices to evaporate into the air volume or headspace above the sample. This gas volume is sampled for subsequent gas chromatography-mass spectrometry analysis and accelerant identification.

47. (B) It adsorbs headspace volatile organics onto its coating for thermal desorption in a gas chromatograph
Solid Phase Microextraction utilizes a fused silica fiber coated with a specialized liquid phase or polymer adsorbent to extract organic compounds. Exposed inside the headspace of a heated fire debris container, the coated fiber adsorbs volatile accelerant molecules, which are then thermally desorbed directly inside the gas chromatograph injection port.

48. (D) Kerosene
Kerosene is a middle distillate petroleum product composed predominantly of straight-chain aliphatic hydrocarbons. Gas chromatography-mass spectrometry analysis of kerosene residues reveals a distinct, regularly spaced homologous series of normal alkanes spanning from C8 or C9 up to C_15 or C_16, providing a characteristic chromatographic pattern that differentiates kerosene from gasoline or heavy oils.

49. (A) Sharp, well-defined, and localized at the point of arcing
Primary electrical arcing produces localized temperatures exceeding two thousand degrees Celsius, causing localized melting of copper conductors prior to widespread fire exposure. This rapid, concentrated melting creates a sharp, well-defined, rounded copper bead situated strictly at the localized arcing point, featuring a distinct boundary between melted and undeformed copper wire sections.

50. (C) P-2, Q-3, R-4, S-1
Effective suppression of structural and chemical fires depends on selecting agents matched to specific combustible fuel classes. Class A solid fires respond best to water cooling. Class B liquid fires require foam or dry chemical blanketing. Class C flammable gas fires are extinguished using carbon dioxide or dry powder, while Class D combustible metal fires require specialized dry powder agents.

51. (A) Backdraft
A backdraft is a tactical fire hazard occurring in oxygen-depleted, under-ventilated enclosure fires containing high concentrations of hot unburned combustion gases. When fresh atmospheric oxygen is abruptly introduced, such as opening a door, the superheated flammable gas mixture rapidly ignites, producing a severe explosive deflagration wave outward through the compartment opening.

52. (D) The preferential loss of lighter, volatile hydrocarbon fractions due to heat or evaporation
Weathering describes the physical alteration of liquid petroleum accelerants exposed to fire heat or environmental evaporation. Volatilization preferentially removes lower-boiling, highly volatile hydrocarbon compounds first, shifting chromatographic mass profiles toward higher molecular weight fractions and requiring forensic examiners to compare weathered residual patterns against modified accelerant reference database standards.

53. (B) Unburned substrate material from the scene used to rule out background volatiles
A negative control in fire debris analysis consists of unburned matrix substrate collected from an unaffected area of the same scene. Analyzing this material accounts for background volatile organic compounds naturally released by pyrolyzed synthetic flooring, adhesives, or carpet padding during heating, ensuring detected accelerant peak patterns are not falsely attributed to substrate pyrolysis products.

54. (C) They allow volatile vapours to escape and can leach interfering plasticizers into samples
Standard polyethylene plastic bags are permeable to low molecular weight volatile hydrocarbons, allowing volatile petroleum vapors to diffuse outward and escape over time. Additionally, plastic polymers can leach organic plasticizers, such as phthalate esters, into evidence samples, causing severe analytical interferences that contaminate chromatographic baselines during gas chromatography-mass spectrometry testing.

Downloaded from www.pdf.tube

ignition in normal air. This process occurs without requiring any localized external ignition source such as a spark, electrical arc, open flame, or pilot light to initiate combustion.

37. (A) Class A
Under standard fire classification systems such as IS 2190, Class A fires involve ordinary solid organic combustible materials including wood, paper, cardboard, textiles, plastics, and rubber. These fires typically form glowing embers during burning and are most effectively suppressed using water or aqueous solutions that lower temperatures below pyrolysis thresholds.

38. (B) Class B
Class B fires involve flammable or combustible liquids and liquefiable solids, including petrol, diesel, kerosene, oil-based paints, solvents, and greases. These fires burn strictly in the gas phase above the liquid surface, requiring smothering extinguishing agents like chemical foam or dry powder to exclude oxygen and suppress continuous fuel vaporization.

39. (D) Any flammable substance used to intentionally initiate or speed the spread of a fire
In forensic fire scene investigation, an accelerant is defined as any flammable or combustible liquid or chemical compound deployed intentionally to initiate, intensify, or rapidly propagate a structural fire. Common examples include petroleum distillates like gasoline, kerosene, and diesel, which leave characteristic volatile hydrocarbon residues within surrounding charred substrate materials.

40. (A) The bottom apex of the "V" pattern generally points toward the fire's point of origin
A classic "V" burn pattern forms on vertical surfaces like walls as hot convective fire gases and flames rise and spread outward during burning. The narrow bottom apex of the V-shape generally points directly down to the lowest burn point, indicating the physical location or origin area where the fire initiated and initially developed.

41. (B) The area showing the deepest charring and lowest point of burn damage
Fires naturally burn upward and outward through convective heat transfer. Consequently, the point of origin usually exhibits the longest duration of exposure to high thermal temperatures. Investigators identify this origin location by searching for areas showing the deepest structural wood charring, low-level floor burning, localized material consumption, and downward burn damage.

NODIA

42. (B) I, II, and IV only
Physical indicators suggesting intentional fire setting include multiple independent points of origin, combustible trailers deployed to connect separate room fires, and irregular pour patterns on flooring displaying sharp demarcation borders. Complete structural destruction does not conclusively establish arson, as accidental fires can fully consume buildings if firefighting efforts are delayed or absent.

43. (A) The cracking or chipping of concrete and masonry surfaces caused by intense heat
Spalling refers to the cracking, flaking, or chipping of concrete, brick, or masonry structural surfaces exposed to intense, high-temperature heat. High thermal radiation rapidly converts trapped internal moisture within concrete pores into expanding steam, causing intense localized internal steam pressure that fractures and spalls the outer surface layers away from underlying aggregate structures.

44. (C) Ensuring personal safety and medical care, then securing the scene
First responders at a fire scene must prioritize human life safety, securing medical emergency aid for injured victims and managing structural hazards. Once safety is assured, establishing physical boundaries and controlling access protects delicate fire origin patterns and volatile chemical evidence from destruction, contamination, or unauthorized removal during overhaul operations.

45. (D) Clean, unlined metal paint cans with airtight lids
Collecting charred fire debris samples suspected of containing volatile ignitable liquids requires specialized vapor-tight containers. Clean, unlined metal paint cans fitted with friction-seal lids prevent the loss of volatile hydrocarbons through evaporation, prevent sample cross-contamination, and ensure structural stability without leaching synthetic plasticizer interferences into the recovered evidence samples during transport.

64. (D) The Explosive Substances Act, 1908
In India, legal prosecution for unlawfully possessing, manufacturing, or deploying completed improvised explosive devices or explosive substances falls under the Explosive Substances Act, 1908. This statute specifically provides severe criminal penalties for activities involving explosive materials intended to endanger human life, cause serious injury, or inflict severe malicious property damage.

65. (A) A crater or localized area of intense fragmentation damage and soot
The seat of explosion represents the immediate epicenter where the primary explosive charge was detonated. Physically, it manifests as a localized physical blast crater, deeply pitted metallic or structural surfaces, concentrated fragmentation damage, high-velocity localized impact scoring, and heavy localized deposition of dark unburned soot and unburned chemical reaction residues.

66. (C) The weathered sample loses early-eluting, highly volatile hydrocarbon peaks
Evaporative weathering preferentially removes lightweight, highly volatile hydrocarbon molecules from fuel mixtures. During gas chromatography analysis, unweathered gasoline displays prominent early-eluting chromatographic peaks corresponding to volatile C_4 to C8 hydrocarbons. Weathered gasoline samples exhibit significant reduction or total absence of these early-eluting peaks, while retaining higher-boiling aromatic and heavy aliphatic constituents.

67. (A) Nitrite ion
The classical Griess test is specific for detecting nitrite ions in aqueous analytical solutions. When analyzing nitrate-based post-blast residues, nitrates must first undergo chemical reduction to nitrites. Nitrite ions then react sequentially with sulfanilic acid and N-(1-naphthyl) ethylenediamine under acidic conditions to yield a bright magenta-pink colored azo dye analytical product.

68. (D) III, IV, I, II
Forensic fire investigation adheres strictly to the scientific method. The process initiates by recognizing the need to determine fire origin and cause. Investigators then collect empirical data through physical scene examination and evidence recovery. Using collected data, analysts develop a logical origin hypothesis, which is systematically tested against evidence before formulating final conclusions.

69. (B) The unknown sample presumptively contains TNT
In thin-layer chromatography, matching retardation factor values between an unknown sample spot and a known reference standard run simultaneously under identical mobile phase conditions indicates chemical similarity. Developing a characteristic red-violet spot upon spraying with alcoholic potassium hydroxide provides strong presumptive chemical evidence that the unknown sample extract contains trinitrotoluene.

70. (C) A smooth, rounded, re-solidified copper bead at a severed wire end
Primary electrical arcing occurring prior to fire ignition generates extreme, localized thermal energy that severs conductors, producing a smooth, solid, rounded copper arc bead at the severed wire tip with a sharp boundary. In contrast, external fire melting creates irregular, blistered, porous copper globulates distributed across extended copper wire lengths.

71. (D) Gas Chromatography-Mass Spectrometry
A Total Ion Chromatogram is a primary chromatographic data representation generated during Gas Chromatography-Mass Spectrometry analysis. The TIC plot displays total ion currents detected across all scanned mass-to-charge ranges as a function of retention time, allowing forensic chemists to isolate individual hydrocarbon peaks and evaluate complex accelerant profiles in fire debris extracts.

72. (A) Fuel oil (Diesel)
Ammonium nitrate is a stable inorganic salt acting as a powerful oxidizer, but it possesses low shock sensitivity. To formulate the commercial blasting agent ANFO, ammonium nitrate prills are soaked with approximately six percent liquid fuel oil, such as diesel, achieving zero oxygen balance and creating a powerful, low-cost secondary explosive mixture.

73. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Headspace GC-MS is the preferred technique for analyzing ignitable liquid residues in fire debris because it selectively samples volatile hydrocarbon vapors from the container gas

Click Here to Buy book on Amazon

CHAPTER 22

Chromatography: TLC, HPLC and GC

1. Who among the following is widely recognised as the father of modern chromatography for his work on the separation of plant pigments?
(A) Edmond Locard
(B) Mikhail Tswett
(C) Archer Martin
(D) Richard Synge

2. In any chromatographic system, the phase that flows through the system and carries the analyte is known as the:
(A) Stationary phase
(B) Eluate
(C) Matrix
(D) Mobile phase

3. Given below are two statements, one labelled as Assertion (A) and the other as Reason (R).
Assertion (A): Paper chromatography is primarily considered a type of partition chromatography.
Reason (R): The moisture trapped in the cellulose network of the paper acts as the stationary phase, while the solvent acts as the mobile phase.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

4. In adsorption chromatography, the separation of components in a mixture is primarily based on their relative:
(A) Solubilities in the fluid mobile phase
(B) Differences in molecular sizes and spatial shapes
(C) Affinities for the solid stationary phase
(D) Differences in electrical charges and ionic radii

5. Which of the following chromatographic techniques separates molecules strictly based on their molecular size and shape?
(A) Size exclusion chromatography
(B) Affinity chromatography
(C) Ion exchange chromatography
(D) Partition chromatography

6. In a standard Normal Phase High Performance Liquid Chromatography (HPLC) setup, which of the following statements is correct regarding the phases used?
(A) The stationary phase is non-polar and the mobile phase is polar.
(B) Both the stationary phase and the mobile phase are highly polar.
(C) Both the stationary phase and the mobile phase are non-polar.
(D) The stationary phase is polar and the mobile phase is non-polar.

7. The time taken by an analyte to pass through a chromatographic column and reach the detector from the point of injection is called its:
(A) Dead time
(B) Retention time
(C) Resolution time
(D) Elution volume

8. Arrange the following steps of Thin Layer Chromatography (TLC) in the correct operational sequence:
I. Development of the chromatogram in a solvent chamber
II. Application of the sample spot on the baseline
III. Visualisation of spots using a suitable reagent
IV. Activation of the TLC plate by heating
(A) II, IV, I, III
(B) IV, I, II, III
(C) IV, II, I, III
(D) II, I, IV, III

9. In the context of chromatography, what is the fundamental purpose of the Van Deemter equation?
(A) To calculate the exact retention time of an unknown analyte during separation.
(B) To relate the total resolving power of a column directly to its overall length.
(C) To determine the optimum concentration of

NODIA

rapid presumptive separation of explosive compounds on coated plates, while Raman spectroscopy performs non-destructive laser identification of suspect bulk powders.

83. (A) Based on its nitrogen content percentage
Nitrocellulose is categorized into distinct functional grades according to its degree of nitration or percentage nitrogen content. Higher nitration levels above thirteen percent produce guncotton, an energetic material used in military propellants and high explosives, whereas lower nitration levels below twelve percent yield collodion, utilized in industrial lacquers, adhesives, and dynamite formulations.

84. (D) It combusts hydrocarbons in a hydrogen flame to create ions measured as electric current
A Flame Ionization Detector operates by passing gas chromatography effluent through an air-hydrogen flame. Pyrolysis of organic hydrocarbon molecules within the flame generates chemical ions and free electrons. These charged species are collected by an electrode held at high voltage, creating a measurable electrical current proportional to hydrocarbon mass concentration.

85. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Plastic explosives like C-4 possess very low vapor pressures, releasing minute quantities of volatile organic molecules into ambient air and rendering vapor-phase detection difficult. Additionally, their pliable polymer matrix allows them to be shaped into thin, flat, or irregular geometric forms that disguise density profiles under routine airport X-ray imaging.

86. (C) Aniline sulphate test
The aniline sulphate test is a presumptive chemical spot test used in forensic screening to identify chlorate ions in low explosive residues. When aniline sulphate reagent is added to a sample containing chlorates in the presence of concentrated sulphuric acid, an intense blue color develops due to oxidation of aniline.

87. (D) I and II only
Lubricating oils are heavy petroleum fractions possessing higher boiling points and carbon chain lengths than diesel fuel. Greases are semi-solid lubricants formulated by dispersing thickening agents, such as metallic soaps, within liquid lubricating base oils. High-quality engine lubricants require a high viscosity index to maintain stable viscosity and fluid film thickness across wide temperature ranges.

88. (A) I, II, and III only
Public Distribution System kerosene in India is deliberately dyed blue using alkyl anthraquinone to prevent illegal diversion into commercial automotive fuels. Forensic laboratories extract and identify this chemical marker dye to prove fuel adulteration. Marker dyes serve purely as visual and chemical tracers and do not alter physical combustion properties such as the fuel's cetane number.

89. (B) P-4, Q-2, R-1, S-3
Chemical spot tests provide rapid preliminary identification of explosive residues. Trinitrotoluene reacts with alcoholic potassium hydroxide to form a distinctive red-violet adduct. Nitrites react with Griess reagent yielding a pink azo dye. Nessler's reagent produces a yellow-brown precipitate with ammonium ions, while nitramines like RDX yield nitrites for diphenylamine testing after alkaline hydrolysis.

90. (B) I, II, and III
Distinguishing accidental electrical fires from incendiary arson involves physical wire examination and residue analysis. Copper conductors damaged by external fire heat exhibit blistered, porous surfaces, whereas primary electrical arcing creates a localized, smooth re-solidified arc bead at severed ends. Finding liquid accelerant traces under short-circuited electrical equipment confirms intentional fire setting disguised as an electrical failure.

www.nodia.in

Downloaded from www.pdf.tube

(B) I, II, and III are correct
(C) II, III, and IV are correct
(D) I, III, and IV are correct

20. Which visualisation reagent is standardly applied on a TLC plate to detect the presence of alkaloids, yielding orange or orange-red spots?
(A) Fast Blue B salt reagent
(B) Concentrated ninhydrin solution
(C) Dragendorff's reagent
(D) Acidified diphenylamine solution

21. In Questioned Document examination, Thin Layer Chromatography (TLC) is routinely used for the comparative analysis of which of the following?
(A) Writing ink composition
(B) Indented writing impressions
(C) Typewriter ribbon mechanical characteristics
(D) Paper watermark design

22. In TLC, when a developed spot is visualised using an iodine chamber, the interaction is generally:
(A) A permanent chemical reaction that alters and destroys the target analyte structure
(B) A radioactive decay process involving high-energy ionising radiation emission
(C) An enzymatic degradation process breaking down complex macromolecular chains
(D) A reversible physical binding of iodine to organic compounds

23. What is the fundamental principle of the Ninhydrin method for detecting latent fingerprints on porous surfaces, which shares its chemical basis with TLC visualisation?
(A) Ninhydrin reacts specifically with lipid components within sweat deposit.
(B) Ninhydrin reacts with amino acids in sweat residue.
(C) Ninhydrin reacts directly with water content present in latent prints.
(D) Ninhydrin acts as a fluorescent dye binding selectively to cellular DNA.

24. Two-dimensional Thin Layer Chromatography is specifically advantageous when:
(A) The mixture contains strictly two distinct volatile organic compounds in solution.
(B) The sample analyzed is extremely concentrated and requires high column volume.
(C) The mixture is complex with overlapping one-dimensional peaks.
(D) A quantitative measurement using a specialized densitometer is strictly required.

25. Given below are two statements, one labelled as Assertion (A) and the other as Reason (R).
Assertion (A): In Gas Chromatography (GC), the mobile phase is always a gas.
Reason (R): The carrier gas chemically interacts with the sample molecules to facilitate their separation in the GC column.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

26. Which of the following components is NOT typically part of a Gas Chromatography system?
(A) High pressure solvent pump
(B) Thermostatted column oven enclosure
(C) Temperature-controlled injection port
(D) High-purity carrier gas cylinder

27. In Gas Chromatography, which type of injection technique is preferred when analysing highly concentrated samples to prevent column overloading?
(A) Splitless injection
(B) Split injection
(C) On-column injection
(D) Direct headspace injection

28. Choose the correct sequence of flow for a sample passing through a basic Gas Chromatography system.
(A) Column → Injector → Detector → Carrier Gas supply
(B) Carrier Gas supply → Injector → Column → Detector
(C) Injector → Carrier Gas supply → Column → Detector
(D) Carrier Gas supply → Column → Injector → Detector

NODIA

29. Capillary columns used in modern Gas Chromatography are typically constructed from:
(A) Fused silica coated with polyimide
(B) Stainless steel
(C) Copper tubing
(D) Borosilicate glass without coating

30. Which technique is most appropriate in Gas Chromatography when separating a mixture

a derivatising agent in solution.
(D) To relate column plate height directly to mobile phase linear velocity.

10. The parameter that measures the ability of a chromatographic column to separate two adjacent peaks is known as:
(A) Resolution
(B) Capacity factor
(C) Theoretical plate number
(D) Selectivity factor

11. Match the chromatography type in List I with its fundamental mechanism in List II.
List I: Chromatography Type
P. Adsorption chromatography
Q. Partition chromatography
R. Ion exchange chromatography
S. Affinity chromatography
List II: Fundamental Mechanism
1. Reversible electrostatic interaction
2. Specific biological or chemical interaction
3. Relative solubility in two liquid phases
4. Surface binding to a solid phase
(A) P-3, Q-4, R-1, S-2
(B) P-4, Q-3, R-1, S-2
(C) P-4, Q-3, R-2, S-1
(D) P-1, Q-2, R-3, S-4

12. If a chromatographic column has a length (L) of 30 cm and the number of theoretical plates (N) is 3000, what is the Height Equivalent to a Theoretical Plate (HETP)?
(A) 0.01 cm
(B) 0.1 cm
(C) 1.0 cm
(D) 10.0 cm

13. Which of the following terms in the Van Deemter equation represents the contribution of multiple flow paths (Eddy diffusion) to band broadening?
(A) The A term
(B) The B term
(C) The C term
(D) The D term

14. Which of the following is an advantage of High Performance Thin Layer Chromatography (HPTLC) over conventional TLC?
(A) It relies entirely on gravitational capillary action to direct mobile solvent flow.
(B) It requires significantly larger volumetric quantities of analytes and solvents.
(C) It uses smaller, uniform particles to achieve superior peak resolution.
(D) It eliminates any requirement for visualising reagents with non-UV active analytes.

15. Consider the following statements regarding retention factor (Rf) in Thin Layer Chromatography:
I. Rf is the ratio of the distance travelled by the solute to the distance travelled by the solvent front.
II. The maximum possible value for Rf is 1.0.
III. Rf values are completely independent of the temperature and solvent system used.
Which of the above statement(s) is/are correct?
(A) II and III are correct
(B) I and III are correct
(C) I, II and III are correct
(D) I and II are correct

16. In paper chromatography, a technique where the solvent is fed to the centre of a circular filter paper and moves outward is called:
(A) Ascending paper chromatography
(B) Descending paper chromatography
(C) Radial or circular chromatography
(D) Two-dimensional paper chromatography

17. The most widely used adsorbent material for coating analytical Thin Layer Chromatography (TLC) plates in laboratories is:
(A) Cellulose
(B) Silica gel
(C) Alumina
(D) Polyamide

18. When performing Thin Layer Chromatography (TLC) for the separation of amino acids in a biological sample, which visualisation reagent is most commonly used to produce purple or blue spots?
(A) Iodine vapour
(B) Dragendorff's reagent
(C) Marquis reagent
(D) Ninhydrin reagent

19. Consider the following statements regarding the selection of a carrier gas in Gas Chromatography:
I. It must be chemically inert.
II. It should be highly pure.
III. It must have a high affinity for the analytes.
IV. Helium, nitrogen, and hydrogen are commonly used as carrier gases.
Which of the above statement(s) is/are correct?
(A) I, II, and IV are correct

Click Here to Buy book on Flipkart

space above the sample. Heating volatilizes accelerants while non-volatile soot, ash, and heavy tars remain trapped in the solid matrix, protecting analytical chromatographic columns from fouling.

74. (B) It physically separates hydrocarbon mixtures based on boiling point differences
Fractional distillation is a physical separation technique that segregates crude petroleum into different hydrocarbon fractions based on variance in boiling points. As crude oil is heated inside distillation columns, components vaporize and rise, condensing at distinct column heights corresponding to their specific boiling points without altering the underlying chemical structure of the hydrocarbons.

75. (A) An impulse-control disorder driven by an obsessive desire to set fires for gratification
Pyromania is formally classified as an impulse-control psychiatric disorder characterized by deliberate, repeated fire setting driven by an internal obsession with fire. Individuals affected by pyromania experience tension before setting a fire and feel emotional release, fascination, or gratification upon watching fires burn, without underlying financial, criminal, or political motives.

76. (C) An intermediate explosive that amplifies shock from the detonator to ignite the main charge
In an explosive train, a booster charge acts as an intermediate bridge between a sensitive detonator and an insensitive main explosive charge. Containing a moderately sensitive high explosive like PETN or RDX, the booster amplifies the initial shock wave generated by the detonator, ensuring complete and reliable initiation of the main high explosive.

77. (D) I, II, and III only
The Explosive Substances Act, 1908 penalizes acts causing explosions likely to endanger life or property, along with attempts or conspiracies to cause explosions regardless of outcome. Making or possessing explosive materials with intent to threaten life or property carries severe penalties. The law encompasses all explosive materials, including commercial, military, and improvised devices.

78. (C) It is unstable and extremely sensitive to mild physical shock
Liquid nitroglycerin exhibits extreme chemical instability and sensitivity to minimal mechanical physical shocks, friction, or thermal fluctuations. Liquid state molecular movement increases collision rates and localized friction hot spots, making ungelatinized nitroglycerin susceptible to accidental detonation during handling, unlike solid high explosives like TNT which remain chemically stable and insensitive to mechanical shock.

79. (B) Wavy, meandering crack lines with smooth edges and no significant hackle marks
Glass fractured by intense thermal stress displays characteristic physical patterns distinct from mechanical impact fractures. Unequal thermal expansion across glass panes induces thermal tension, producing smooth, wavy, serpentine, or meandering fracture crack lines across the glass surface. These thermal stress fractures lack high-velocity mechanical impact points, radial impact patterns, or pronounced surface hackle marks.

NODIA

80. (B) 660 degrees Celsius
Pure aluminum possesses a well-defined physical melting point of approximately 660 degrees Celsius. Finding melted aluminum components at a fire scene, such as window frames, engine blocks, or household fixtures, provides fire investigators with a reliable physical temperature indicator, confirming localized compartment fire temperatures exceeded 660 degrees Celsius during burning.

81. (A) Explosive Vapor Detector (EVD)
An Explosive Vapor Detector serves as an analytical instrument mirroring the biological detection capabilities of trained canine olfactory systems. EVD devices collect and analyze airborne volatile organic vapors or trace microscopic explosive particles using electron capture detection, thermo-redox analysis, or ion mobility spectrometry to identify concealed explosives in field environments.

82. (C) P-3, Q-2, R-4, S-1
Forensic analysis utilizes target-specific analytical instrumentation. Ion chromatography quantifies inorganic post-blast aqueous ions like nitrates and chlorates. Gas chromatography-mass spectrometry profiles complex organic accelerants. Thin-layer chromatography provides

of compounds that have a very wide range of boiling points?
(A) Isothermal operation
(B) Changing the carrier gas mid-run
(C) Temperature programming
(D) Reversing the column flow

31. The Flame Ionisation Detector (FID) in Gas Chromatography is highly sensitive to which class of compounds?
(A) Fully oxidised inorganic compounds such as carbon dioxide gas
(B) Noble and inert gaseous elements like argon, helium, and neon
(C) Pure water vapour and aqueous moisture fractions
(D) Organic compounds with carbon-hydrogen bonds

32. In a toxicology laboratory, estimating blood alcohol concentration (BAC) is predominantly performed using which specialized GC technique?
(A) Pyrolysis Gas Chromatography
(B) Inverse Gas Chromatography
(C) Headspace Gas Chromatography
(D) Preparative Gas Chromatography

33. Match the Gas Chromatography detectors in List I with their key characteristics or target analytes in List II.
List I: Gas Chromatography Detector
P. Flame Ionisation Detector (FID)
Q. Electron Capture Detector (ECD)
R. Nitrogen Phosphorus Detector (NPD)
S. Thermal Conductivity Detector (TCD)
List II: Key Characteristic / Target Analyte
1. Universal detector, measures changes in thermal resistance
2. Highly sensitive to halogenated compounds
3. General detector for combustible organic compounds
4. Highly specific for nitrogen- and phosphorus-containing drugs
(A) P-1, Q-2, R-3, S-4
(B) P-3, Q-2, R-4, S-1
(C) P-3, Q-4, R-2, S-1
(D) P-4, Q-2, R-1, S-3

34. Pyrolysis Gas Chromatography (Py-GC) is a valuable technique in analytical evidence analysis primarily for the examination of:
(A) Reconstructed bloodstain distribution patterns
(B) Traces of volatile liquid accelerants from arson
(C) Highly toxic volatile poisons like hydrogen cyanide
(D) Insoluble polymers such as paints and fibers

35. When Gas Chromatography is coupled with Mass Spectrometry (GC-MS), what serves as the primary function of the mass spectrometer?
(A) It ionises compounds and separates them by mass-to-charge ratio.
(B) It acts merely to detect the non-specific presence of any gas eluting from the column.
(C) It separates complex volatile molecules based strictly on their physical boiling points.
(D) It absorbs monochromatic UV light to identify specific functional chromophores.

36. Which of the following carrier gases provides the highest optimal linear velocity range and is thus favoured for fast GC analysis, despite safety concerns?
(A) Nitrogen
(B) Argon
(C) Hydrogen
(D) Helium

37. The process of modifying a non-volatile or thermally unstable analyte into a volatile and stable form prior to GC analysis is called:
(A) Derivatization
(B) Extraction
(C) Polymerization
(D) Sublimation

NODIA

38. Consider the following statements regarding the Electron Capture Detector (ECD) in GC:
I. It uses a radioactive source, typically Nickel-63.
II. It is highly sensitive to electronegative functional groups.
III. It is universally sensitive to all aliphatic hydrocarbons.
Which of the above statement(s) is/are correct?
(A) I and III are correct
(B) II and III are correct
(C) I, II, and III are correct
(D) I and II are correct

39. In GC-MS analysis, the Total Ion Chromatogram (TIC) represents:
(A) The full mass fragmentation spectrum of a single eluting compound.
(B) A plot of total ion intensity versus retention time.

(C) Concentration and Time
(D) Mass-to-charge ratio and Relative Abundance

76. The term "eluent" in liquid chromatography refers to:
(A) The mobile phase exiting the column
(B) The mobile phase entering the column
(C) The solid particles packed inside the column
(D) The sample prior to injection

77. Match the liquid chromatography variants in List I with their distinguishing features in List II.
List I: Liquid Chromatography Variant
P. Normal Phase LC
Q. Reversed Phase LC
R. Ion Exchange LC
S. Size Exclusion LC
List II: Distinguishing Feature
1. Mobile phase is more polar than the stationary phase
2. Uses porous beads; smaller molecules take longer to elute
3. Mobile phase is less polar than the stationary phase
4. Employs cationic or anionic resins
(A) P-3, Q-1, R-4, S-2
(B) P-1, Q-3, R-4, S-2
(C) P-3, Q-1, R-2, S-4
(D) P-4, Q-2, R-1, S-3

78. In an automated GC system used in an analytical laboratory, the autosampler is advantageous because it:
(A) Significantly increases the chromatographic resolving power and theoretical plate count of column.
(B) Completely removes the requirement for continuous high-purity carrier gas supply lines.
(C) Improves reproducibility of injection volumes and retention times.
(D) Dynamically alters mobile phase composition based automatically on detected analyte type.

79. When conducting TLC analysis of synthetic dyes, if the solvent front travels 8 cm and the dye spot travels 4 cm from the baseline, the Rf value is:
(A) 0.2
(B) 0.5
(C) 2.0
(D) 4.0

80. Affinity chromatography is highly specialized and is primarily used in biochemistry for the purification of:
(A) Low-boiling volatile organic solvents and industrial diluents
(B) Short-chain, small hydrocarbon gases like methane and ethane
(C) Biomolecules like enzymes, antibodies, or DNA
(D) Insoluble metallic trace elements and heavy inorganic ions

81. Consider the following statements regarding the coupling of Gas Chromatography with Mass Spectrometry (GC-MS):
I. The GC-MS interface must transfer the sample from a high-pressure environment to a high-vacuum environment.
II. The eluent from the GC must be converted into a liquid spray before entering the MS.
III. Helium is widely used as the carrier gas because its low mass allows it to be easily removed by vacuum pumps.
Which of the above statement(s) is/are correct?
(A) I and II are correct
(B) I and III are correct
(C) II and III are correct
(D) I, II, and III are correct

82. In paper chromatography, which type of paper is most routinely used as the support medium?
(A) Polytetrafluoroethylene (PTFE) membrane
(B) Glass microfibre filter
(C) Nylon membrane filter
(D) Whatman filter paper (pure cellulose)

83. The process of sweeping the volatile components from a solid or liquid sample matrix directly into a GC column using heat and a flow of inert gas is known as:
(A) Purge and trap dynamic headspace
(B) Dispersive liquid-liquid solvent microextraction
(C) Automated solid-phase sorbent cartridge extraction
(D) Constant composition mobile phase isocratic elution

84. Which of the following GC detectors is considered destructive to the sample?
(A) Thermal Conductivity Detector (TCD)
(B) Electron Capture Detector (ECD)

Downloaded from www.pdf.tube

STUDYING FROM PDFs?

THINK AGAIN.

If you are studying only from PDFs,
you are wasting valuable time.

Research shows that learning from

PRINTED BOOKS has up to

4× HIGHER RETENTION

than studying from screens.

PRINT BOOK = BETTER MEMORY

PDF = LOWER RETENTION

Those who study from **PRINTED BOOKS**
move **AHEAD.**

Others are left **BEHIND**
in competition.

In competitive exams,
being average is not enough.

STAY ONE STEP AHEAD.

Spectrometry (LC-MS) for toxicological analysis is:
(A) Electron Impact (EI)
(B) Electrospray Ionization (ESI)
(C) Fast Atom Bombardment (FAB)
(D) Matrix-Assisted Laser Desorption/Ionization (MALDI)

50. In quantitative chromatographic analysis, the concentration of an unknown analyte is typically determined by measuring the:
(A) Measured peak width at half maximum height
(B) Absolute retention time of the target peak
(C) Measured distance between two adjacent peaks
(D) Area or height of the peak

51. The "Internal Standard" method is often used in quantitative GC and HPLC. What is an internal standard?
(A) A known compound added in equal amounts to all samples and standards.
(B) A standard reference procedure manual maintained routinely within the testing laboratory.
(C) An external calibration plot comparing known solute concentrations to detector responses.
(D) A high-purity standard gas stream utilised to flush analytical columns prior to testing.

52. Arrange the following steps involved in a typical quantitative drug analysis using HPLC in the correct sequential order:
I. Preparation of a calibration curve from standards
II. Extraction of the drug from the biological matrix
III. Calculation of the unknown concentration
IV. Injection of the sample extract into the HPLC system
(A) II, IV, I, III
(B) II, I, IV, III
(C) I, II, IV, III
(D) I, IV, II, III

53. Which problem is uniquely associated with LC-MS analyses of complex biological samples and involves the alteration of ionization efficiency by co-eluting matrix components?
(A) Matrix-induced ion suppression or enhancement
(B) Multiple path solute dispersion, also known as Eddy diffusion
(C) Thermal stationary phase breakdown leading to column bleed
(D) Fluctuations in system column compartment temperature drift

54. In explosive analysis, HPLC is often selected over GC for compounds like RDX and HMX. What is the primary reason for this preference?
(A) RDX and HMX inorganic molecules do not contain carbon atoms in their molecular structure.
(B) These compounds are exceptionally volatile liquids that rapidly escape standard GC detection.
(C) HPLC analysis of these explosives completely eliminates the need for sample preparation.
(D) They are thermally labile and decompose in hot GC injectors.

55. Match the applications in List I with the most appropriate chromatographic technique in List II.
List I: Application
P. Identification of complex volatile ignitable liquid residues
Q. Separation of thermally unstable designer drugs
R. Preliminary screening of ink from a document
S. Structural fingerprinting of automotive paint chips
List II: Chromatographic Technique
1. Thin Layer Chromatography (TLC)
2. Pyrolysis Gas Chromatography (Py-GC)
3. High Performance Liquid Chromatography (HPLC)
4. Gas Chromatography-Mass Spectrometry (GC-MS)
(A) P-3, Q-4, R-2, S-1
(B) P-4, Q-3, R-1, S-2
(C) P-4, Q-1, R-3, S-2
(D) P-2, Q-3, R-1, S-4

NODIA

56. Solid Phase Extraction (SPE) is a pre-treatment method frequently used before HPLC or GC analysis. Its primary purpose is to:
(A) Derivatize the analyte for better volatility.
(B) Cool the sample to prevent degradation.
(C) Clean up the sample matrix and concentrate the analytes.
(D) Convert liquid samples into solid pellets for direct injection.

(C) The programmed operating temperature profile of the internal GC oven.
(D) The specific multi-point calibration curve used for quantitative analysis.

40. High Performance Liquid Chromatography (HPLC) is often preferred over GC for analysis when the analytes are:
(A) Highly volatile and thermally stable
(B) Gaseous at room temperature
(C) Non-volatile, thermally fragile, or highly polar
(D) Completely insoluble in organic and aqueous solvents

41. In an HPLC system, what is the primary function of the guard column?
(A) To act as the primary structural site for achieving analytical separation.
(B) To thoroughly degas the mobile phase mixture before it reaches the pump head.
(C) To continuously detect target analytes immediately after they elute from column.
(D) To protect the analytical column from particles and contaminants.

42. In reversed-phase HPLC, the stationary phase is non-polar. As a result, which type of compounds will elute first from the column?
(A) The most polar compounds
(B) The most non-polar compounds
(C) Compounds with the highest molecular weight
(D) Compounds with the lowest molecular weight

43. Which of the following is the most commonly used non-polar stationary phase material in reversed-phase HPLC columns?
(A) Unmodified porous bare silica
(B) C_18 bonded silica
(C) Highly active acidic alumina
(D) Cyanopropyl stationary bonded silica

44. Consider the following components of a modern HPLC system:
I. Solvent reservoir
II. High-pressure pump
III. Rheodyne injector
IV. Column oven
Which combination represents the components directly responsible for moving and introducing the sample into the mobile phase stream?
(A) I and IV
(B) II and III
(C) I, II and IV
(D) III and IV

45. In HPLC, a method where the composition of the mobile phase remains constant throughout the entire chromatographic run is termed:
(A) Isocratic elution
(B) Gradient elution
(C) Stepwise elution
(D) Programmed elution

46. The Photodiode Array (PDA) detector in HPLC has a significant advantage over a standard single-wavelength UV-Vis detector because it can:
(A) Efficiently detect organic molecules that do not absorb light in UV region.
(B) Fully vaporise the liquid sample matrix for downstream mass spectral analysis.
(C) Record full UV-Vis spectra of analytes simultaneously upon elution.
(D) Operate reliably in liquid chromatography without any mobile phase flow.

47. Which HPLC detector works on the principle of exciting the analyte molecules with light and measuring the longer-wavelength light emitted as the molecules return to the ground state?
(A) Refractive Index (RI) detector
(B) Electrochemical detector
(C) Evaporative Light Scattering Detector (ELSD)
(D) Fluorescence detector

48. Given below are two statements, one labelled as Assertion (A) and the other as Reason (R).
Assertion (A): Ultra High Performance Liquid Chromatography (UHPLC) provides better resolution and faster analysis times compared to standard HPLC.
Reason (R): UHPLC utilizes columns packed with sub-2-micron particles, which significantly minimizes band broadening according to the Van Deemter equation.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

49. The most common ionization technique used to interface Liquid Chromatography with Mass

Click Here to Buy book on Amazon

analytes.
(C) To divert column effluent to six separate analytical detectors simultaneously during a run.
(D) Inject precise sample volumes into high-pressure flow without stopping it.

67. The phenomenon where two or more compounds elute from a chromatographic column at the exact same retention time is known as:
(A) Co-elution
(B) Gradient elution
(C) Resolution
(D) Isomerization

68. Consider the following statements regarding the Nitrogen Phosphorus Detector (NPD):
I. It is also known as the Thermionic Specific Detector (TSD).
II. It uses a heated alkali bead (usually rubidium or cesium) in its operation.
III. It is highly specific to hydrocarbons and ignores nitrogenous compounds.
IV. It is extensively used in toxicology for detecting alkaloids and organophosphate pesticides.
Which of the above statement(s) is/are correct?
(A) I, II, and III are correct
(B) II, III, and IV are correct
(C) I, II, and IV are correct
(D) I, III, and IV are correct

69. In a reversed-phase HPLC analysis of a mixture of drugs, increasing the percentage of the organic solvent (e.g., acetonitrile) in the water/organic mobile phase will generally result in:
(A) Decreased retention times for all analytes
(B) Increased retention times for all analytes
(C) No change in retention times
(D) Complete loss of column pressure

70. When an analyst reports a "baseline resolution" between two critical drug peaks, the calculated resolution (Rs) value is typically at least:
(A) 0.5
(B) 1.0
(C) 1.5
(D) 10.0

71. Given below are two statements, one labelled as Assertion (A) and the other as Reason (R).
Assertion (A): Derivatizing reagents such as BSTFA are commonly used in the GC analysis of polar compounds like sugars and certain drugs.
Reason (R): Silylation with BSTFA replaces active hydrogens with trimethylsilyl groups, reducing polarity and increasing volatility and thermal stability of the analyte.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

NODIA

72. Which of the following LC-MS applications is most relevant to the examination of biological fluids in forensic toxicology?
(A) Determining the exact geographic and mineralogical origin of a forensic soil sample.
(B) Microscopic matching and comparison of individual striations on a fired bullet specimen.
(C) Screening and quantifying synthetic cannabinoids and opiates.
(D) Measuring the precise optical refractive index of microscopic forensic window glass shards.

73. In preparative chromatography, the primary goal of the separation process is to:
(A) Identify the complete chemical structure and functional groups of unknown substances.
(B) Accurately determine the exact trace concentration of minor sample impurities.
(C) Completely destroy sample material to measure its enthalpy or heat of combustion.
(D) Isolate and collect purified compounds for further use.

74. Which of the following best describes the principle of Ion Exchange Chromatography?
(A) Molecules separate via electrostatic interaction with charged stationary groups.
(B) Molecules are separated based on their differential solubility and partition into an immobilized liquid film.
(C) Molecules are separated according to hydrodynamic volume as they pass through pores in a polymer gel matrix.
(D) Molecules are separated through highly specific, high-affinity biological antigen-antibody binding interactions.

75. In a typical HPLC chromatogram, the x-axis and y-axis respectively represent:
(A) Wavelength and Absorbance
(B) Time and Detector Response (e.g., mAU)

ANSWERS

1. (B) Mikhail Tswett
Mikhail Tswett is universally acknowledged as the father of modern chromatography. In 1906, he developed the technique to separate various plant pigments, such as chlorophylls and carotenoids, using a glass column packed with calcium carbonate. His pioneering work established the fundamental principles of column separation, leading to the rapid development of modern chromatographic science.

2. (D) Mobile phase
In any chromatographic separation, the system consists of a stationary phase and a mobile phase. The mobile phase is the fluid, either liquid or gas, that moves continuously through the chromatographic column or layer. It carries the sample mixture along, facilitating differential interaction and separation of components based on their individual distribution coefficients across phases.

3. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Paper chromatography functions predominantly through a liquid-liquid partition mechanism. Cellulose fibers in filter paper adsorb water moisture from the surrounding environment or solvent mixture, forming a bound aqueous stationary liquid phase. As the organic mobile phase travels over the paper, sample analytes partition differentially between the trapped stationary water phase and the moving organic liquid.

4. (C) Affinities for the solid stationary phase
Adsorption chromatography relies on competitive binding between solute molecules and the mobile phase for active adsorption sites on a solid stationary surface, such as silica or alumina. Analytes with stronger affinity for the stationary phase adsorb more tightly and elute more slowly, whereas weakly adhering components move rapidly with the moving fluid phase.

5. (A) Size exclusion chromatography
Size exclusion chromatography, also known as gel filtration or gel permeation chromatography, separates molecules solely according to hydrodynamic size and molecular mass. Large molecules cannot penetrate the pores of the porous stationary gel matrix and elute first, while smaller molecules enter the pores, experience an increased path length, and elute significantly later from the column.

6. (D) The stationary phase is polar and the mobile phase is non-polar.
Normal Phase High Performance Liquid Chromatography utilizes a strongly polar stationary phase, such as bare silica gel, and a non-polar organic mobile phase, such as hexane or heptane. Consequently, polar analytes interact strongly with the stationary phase and retain longer, while non-polar compounds dissolve readily in the mobile phase and elute earlier.

7. (B) Retention time
Retention time is defined as the total duration required for an analyte to travel from the point of sample injection through the column to the detector signal output. It serves as a characteristic parameter in chromatography used for qualitative identification, as each analyte exhibits a specific retention time under fixed operational conditions.

8. (C) IV, II, I, III
Thin Layer Chromatography follows a strict operational sequence. First, the TLC plate is activated by heating in an oven to remove adsorbed atmospheric moisture. Next, the sample solution is spotted on the baseline. The plate is then placed in a solvent chamber for development. Finally, separated spots are visualised using appropriate reagents or light.

9. (D) To relate column plate height directly to mobile phase linear velocity.
The Van Deemter equation mathematically expresses the height equivalent to a theoretical plate as a function of mobile phase linear velocity. By accounting for eddy diffusion, longitudinal diffusion, and resistance to mass transfer, the equation allows chromatographers to identify the optimal mobile phase flow rate that minimizes plate height and maximizes separation efficiency.

Downloaded from www.pdf.tube

(C) Flame Ionization Detector (FID)
(D) Infrared Detector (IRD)

85. When developing a TLC plate, it is essential to keep the solvent development chamber tightly covered. The primary reason for this is to:
(A) Maintain solvent vapour saturation for uniform capillary rise.
(B) Prevent the mobile phase solvent from reacting with surrounding atmospheric oxygen gas.
(C) Shield sensitive organic samples on the plate from ambient light degradation during run.
(D) Prevent fine environmental dust particles from settling directly onto the TLC plate surface.

86. Which of the following is NOT an advantage of using a capillary column over a packed column in Gas Chromatography?
(A) Higher separation efficiency (more theoretical plates)
(B) Faster analysis times
(C) Better resolution of complex mixtures
(D) Higher sample loading capacity

87. In an HPLC analysis, "column void volume" or "dead volume" refers to:
(A) The total physical mass and volume occupied by stationary phase material itself.
(B) The mobile phase volume inside the column excluding stationary phase.
(C) The maximum permissible liquid volume of sample that can be directly injected.
(D) The overall liquid capacity volume of the main solvent supply reservoir bottle.

88. When an analyst is tasked with identifying an unknown chemical compound, after GC-MS analysis, identification is definitively made by comparing the acquired mass spectrum with a:
(A) Theoretical Van Deemter velocity optimization plot
(B) Thin layer chromatography Rf value reference chart
(C) Standard mass spectral library (NIST/ SWGDRUG)
(D) Quantitative multi-point instrument calibration curve

89. In the context of Gas Chromatography, "column bleed" is defined as:
(A) The physical leakage of high-pressure carrier gas from a loose column fitting.
(B) The severe overlapping and co-elution of two adjacent target analyte peaks.
(C) The permanent, irreversible chemical binding of sample components to column walls.
(D) Stationary phase degradation and elution at high temperatures.

90. Which of the following solvent systems would be most appropriate for the normal phase TLC separation of a mixture of highly polar drugs?
(A) Polar solvent mixture with methanol or ethyl acetate
(B) Pure 100% non-polar organic solvent consisting strictly of hexane
(C) Pure 100% non-polar organic solvent consisting strictly of heptane
(D) A binary non-polar solvent mixture composed of hexane and mineral oil

www.nodia.in

NODIA

57. In a chromatogram, a peak that shows significant "tailing" indicates an asymmetry factor that is:
(A) Exactly equal to 1.0
(B) Less than 1.0
(C) Zero
(D) Greater than 1.0

58. The Limit of Detection (LOD) in a chromatographic method is defined as the lowest concentration of an analyte that can be:
(A) Distinguished from background noise at a 3:1 signal-to-noise ratio.
(B) Reliably quantified with an analytical precision better than 1% relative standard deviation.
(C) Easily detected visually by human observation without reliance on any instrumental aid.
(D) Accurately calibrated and quantified using the multi-point internal standard method.

59. When analyzing fire debris for ignitable liquid residues, which sample preparation method is most commonly coupled with GC-MS?
(A) Biphasic liquid-liquid solvent extraction performed with heavy water
(B) Headspace SPME or heated headspace extraction
(C) High-pressure supercritical fluid extraction utilizing carbon dioxide
(D) Size exclusion membrane filtration for macromolecular separation

60. Consider the following parameters affecting the separation in a GC capillary column:
I. Column internal diameter
II. Stationary phase film thickness
III. Carrier gas flow rate
Which of the above statement(s) is/are correct?
(A) I and II only affect separation.
(B) I, II, and III all affect separation.
(C) I and III only affect separation.
(D) II and III only affect separation.

61. Which of the following equations correctly expresses the Retention Factor (k) or Capacity Factor of an analyte, where tr is retention time and t0 is dead time?
(A) $k = (t_r - t_0) / t_0$
(B) $k = t_r / t_0$
(C) $k = (t_r + t_0) / t_0$
(D) $k = t_0 / (t_r - t_0)$

62. Which structural feature of a molecule makes it most suitable for detection by an Electron Capture Detector (ECD) in GC?
(A) Presence of a fully saturated, unbranched long aliphatic alkane chain
(B) Presence of an unsubstituted aliphatic or aromatic primary amine group
(C) Presence of halogens like chlorine or fluorine
(D) Presence of an unesterified aliphatic or phenolic hydroxyl group

63. In High Performance Liquid Chromatography, mobile phase solvents must be degassed prior to use. If not degassed, what is the most likely adverse effect?
(A) The solid stationary phase packing material will immediately and irreversibly dissolve.
(B) The target organic analytes will undergo spontaneous thermal and chemical derivatization.
(C) The UV-Vis optical detector system will automatically shut down as a safety precaution.
(D) Air bubbles form in the pump or detector, causing baseline noise.

64. Select the correct sequence of steps for identifying a drug from a blood sample using LC-MS.
(A) Blood collection → LC separation → Protein precipitation/Extraction → MS detection → Data interpretation
(B) LC separation → Blood collection → MS detection → Protein precipitation/ Extraction → Data interpretation
(C) Blood collection → Protein precipitation/ Extraction → LC separation → MS detection → Data interpretation
(D) Protein precipitation/Extraction → LC separation → Blood collection → Data interpretation → MS detection

65. The term "WCOT" regarding Gas Chromatography columns stands for:
(A) Water-Cooled Operational Tubing
(B) Wall-Coated Open Tubular
(C) Wide-Column Optimal Temperature
(D) Window-Coupled Optical Target

66. A 6-port Rheodyne valve is universally used in HPLC systems. Its primary function is:
(A) To thoroughly mix up to six different proportioned mobile phase solvent reservoirs.
(B) To serve continuously as an automated fraction collector for up to six distinct

Click Here to Buy book on Flipkart

10. (A) Resolution
Resolution represents a quantitative measure of the degree of physical separation between two adjacent peaks on a chromatogram. It accounts for both the difference in peak retention times and the widths of the respective peaks. A resolution value of 1.5 or greater generally indicates baseline separation between two closely eluting chemical components.

11. (B) P-4, Q-3, R-1, S-2
Chromatographic techniques are classified by their primary separation mechanism. Adsorption chromatography involves surface binding to a solid phase. Partition chromatography depends on relative solubility between two liquid phases. Ion exchange chromatography relies on reversible electrostatic interactions with charged groups. Affinity chromatography utilizes specific biological or chemical interactions between ligands and targeted target molecules.

12. (A) 0.01 cm
Height Equivalent to a Theoretical Plate measures column efficiency and is calculated using the formula HETP = Column Length divided by Number of Theoretical Plates. Substituting 30 cm for column length and 3000 for theoretical plates yields 30 cm / 3000 = 0.01 cm. Smaller HETP values reflect greater efficiency and higher resolving power.

13. (A) The A term
In the Van Deemter equation, the A term represents Eddy diffusion, which accounts for the multiple flow pathways that solute molecules take through packed columns. Because packed particle pathways vary in length, solute molecules arrive at different times, causing band broadening. Open tubular capillary columns eliminate this term since only a single channel exists.

14. (C) It uses smaller, uniform particles to achieve superior peak resolution.
High Performance Thin Layer Chromatography enhances performance over conventional TLC by using plates coated with much smaller, highly uniform silica particles. This significantly reduces band broadening, improves overall separation efficiency, increases sensitivity, and allows for sharper peak resolution with reduced solvent consumption and much shorter development distances and analytical run times.

15. (D) I and II are correct
Retention factor in thin layer chromatography is defined as solute distance divided by solvent front distance. Because the solvent front always travels farther than or equal to the solute, the maximum possible retention factor value is 1.0. However, retention factor values depend heavily on experimental parameters such as temperature, solvent composition, and humidity.

16. (C) Radial or circular chromatography
Radial or circular paper chromatography involves applying sample spots around the center of a circular paper disc. Solvent is delivered to the central point via a wick, causing the mobile phase to migrate radially outward. Analytes separate into concentric circular arcs based on their differential partition coefficients between stationary water and moving solvent.

17. (B) Silica gel
Silica gel is the most widely utilized adsorbent in analytical thin layer chromatography. It consists of a porous network of silanol groups, providing a polar surface capable of strong hydrogen bonding and dipole interactions. This makes silica gel highly effective for separating a vast range of organic compounds, pharmaceuticals, and environmental samples.

18. (D) Ninhydrin reagent
Ninhydrin is a classic visualization reagent used in thin layer chromatography to detect amino acids, peptides, and primary amines. Upon heating, ninhydrin reacts specifically with the free alpha-amino groups present in these compounds to produce a characteristic deep purple or blue colored complex known as Ruhemann's purple, enabling visual identification.

19. (A) I, II, and IV are correct
Carrier gases in gas chromatography act strictly as inert mobile phases designed to transport volatilized analytes without chemical interaction. Suitable carrier gases, such as helium, nitrogen, and hydrogen, must possess exceptional purity and complete chemical inertness toward both sample analytes and column stationary phases to ensure accurate, repeatable retention times.

20. (C) Dragendorff's reagent
Dragendorff's reagent, composed of potassium bismuth iodide, is the standard visualization reagent used in thin layer chromatography for

Downloaded from www.pdf.tube

the screening and detection of alkaloids and tertiary nitrogen bases. Spraying a TLC plate with Dragendorff's reagent yields distinct orange or reddish-orange spots where alkaloid compounds are localized on the stationary layer.

21. (A) Writing ink composition
Thin layer chromatography is widely applied in questioned document examination to compare writing inks. Ink micro-extracts are separated into individual dye components and pigments on a TLC plate. By comparing retention factors and spot patterns against reference standard inks, examiners can determine ink consistency, identify manufacturers, or detect document alterations.

22. (D) A reversible physical binding of iodine to organic compounds
Iodine visualization in thin layer chromatography relies on the physical adsorption or reversible formation of weak charge-transfer complexes between iodine vapor and organic molecules, particularly unsaturated or aromatic compounds. As iodine reversibly binds, transient brown or yellow spots develop. Upon removal from iodine vapor, the iodine sublimates away without permanently altering analytes.

23. (B) Ninhydrin reacts with amino acids in sweat residue.
Latent fingerprints deposited on porous materials like paper contain eccrine sweat residue rich in amino acids. Ninhydrin reacts specifically with these terminal amino acid groups upon heating, undergoing chemical condensation to yield a purple product known as Ruhemann's purple. This reaction visualizes friction ridge patterns with high contrast and analytical clarity.

24. (C) The mixture is complex with overlapping one-dimensional peaks.
Two-dimensional thin layer chromatography is designed to separate complex chemical mixtures that exhibit overlapping spots during single-direction development. After the initial solvent run, the chromatographic plate is rotated ninety degrees and developed using a second mobile phase with different polarity, drastically increasing peak capacity and effectively resolving co-eluting component spots.

25. (C) Assertion (A) is true but Reason (R) is false.
In gas chromatography, the mobile phase is invariably an inert gas such as helium, nitrogen, or hydrogen. Its sole purpose is to sweep sample vapor through the column. Unlike liquid chromatography mobile phases, carrier gases must remain chemically inert and do not interact or react with analyte molecules to effect separation.

26. (A) High pressure solvent pump
A high pressure solvent pump is an integral hardware component of liquid chromatography systems, where high hydraulic pressure is required to force liquid solvents through tightly packed columns. Gas chromatography systems rely on pressurized compressed gas cylinders or gas generators rather than liquid solvent pumps to maintain mobile phase flow.

27. (B) Split injection
Split injection mode in gas chromatography is specifically designed for high-concentration sample analysis to prevent exceeding column sample capacity. Upon injection and flash vaporization, only a small, precisely controlled fraction of sample vapor enters the capillary column, while the remaining majority is safely vented away through a split exhaust valve line.

28. (B) Carrier Gas supply → Injector → Column → Detector
In gas chromatography, flow follows a sequential path. High-purity carrier gas flows continuously from its supply source into the heated injection port. The injected sample vaporizes instantly and is swept by carrier gas into the analytical column for separation. Finally, separated analytes elute sequentially into the detector for signal recording.

NODIA

29. (A) Fused silica coated with polyimide
Modern open tubular capillary columns used in gas chromatography are fabricated from high-purity fused silica glass tubing. To impart high flexibility and mechanical strength, the exterior surface of the delicate silica capillary is coated with a thin protective layer of polyimide polymer, preventing breakage while permitting operation under elevated oven temperatures.

30. (C) Temperature programming
When separating complex chemical mixtures containing compounds with widely varying

boiling points, temperature programming is essential in gas chromatography. By progressively raising the column oven temperature during an analytical run, low-boiling components elute rapidly at lower temperatures, while high-boiling compounds migrate much faster as temperature increases, producing well-resolved, sharp peaks.

31. (D) Organic compounds with carbon-hydrogen bonds
The Flame Ionisation Detector is a widely used gas chromatography detector that pyrolyzes eluting sample solutes in a hydrogen-air flame. Pyrolysis generates CH radicals that form ions, creating an electrical current proportional to carbon content. Consequently, it exhibits exceptional sensitivity toward organic molecules containing carbon-hydrogen bonds while remaining insensitive to fully oxidized carbon or inorganic gases.

32. (C) Headspace Gas Chromatography
Headspace gas chromatography is the standard analytical technique for measuring blood alcohol concentration in forensic toxicology. Blood samples are sealed in airtight vials and heated to establish thermodynamic equilibrium between liquid and vapor phases. The vapor headspace containing volatile ethanol is injected into the column, preventing non-volatile biological matrix contamination.

33. (B) P-3, Q-2, R-4, S-1
Gas chromatography detectors possess distinct selectivity characteristics. Flame ionisation detectors respond broadly to combustible hydrocarbons. Electron capture detectors utilize radioactive Nickel-63 sources to selectively detect electronegative, halogenated molecules. Nitrogen phosphorus detectors employ heated alkali beads to target nitrogen and phosphorus drugs. Thermal conductivity detectors operate as universal detectors measuring changes in carrier gas thermal conductivity.

34. (D) Insoluble polymers such as paints and fibers
Pyrolysis Gas Chromatography is an essential analytical technique for analyzing non-volatile, insoluble polymeric solids such as automotive paint chips, synthetic fibers, and commercial rubbers. Rapid thermal degradation in an inert atmosphere breaks complex macromolecular structures into characteristic volatile fragment patterns, producing distinctive pyrogram fingerprints that allow precise forensic comparison and chemical identification.

35. (A) It ionises compounds and separates them by mass-to-charge ratio.
In a gas chromatography-mass spectrometry system, the mass spectrometer serves as a sophisticated detector. Eluting gaseous molecules undergo ionization, typically via electron impact or chemical ionization, breaking into charged fragments. These ions are separated according to mass-to-charge ratios by electromagnetic fields, producing structural mass spectra that enable definitive identification of unknown analytes.

36. (C) Hydrogen
Hydrogen provides the highest optimal linear velocity and flattest Van Deemter curve among common gas chromatography carrier gases. This allows high linear velocities without sacrificing separation efficiency, enabling significantly faster analytical run times. However, because hydrogen forms explosive mixtures with air, rigorous leak detection and safety precautions are required during laboratory use.

37. (A) Derivatization
Derivatization is a chemical pre-treatment process used prior to gas chromatography to chemically modify analytes containing active hydrogen atoms, such as polar hydroxyl, carboxyl, or amino groups. By replacing polar functional groups with less polar substituents like trimethylsilyl groups, derivatization increases volatility, thermal stability, and peak symmetry during analytical separation.

38. (D) I and II are correct
The electron capture detector contains a beta-emitting radioactive isotope, usually Nickel-63, which ionizes carrier gas to produce a steady standing current. Electronegative analytes, particularly halogenated pesticides and polychlorinated biphenyls, capture thermal electrons and reduce current output, providing extreme sensitivity. However, saturated aliphatic hydrocarbons lack electronegative groups and do not trigger response.

39. (B) A plot of total ion intensity versus retention time.
In gas chromatography-mass spectrometry, a Total Ion Chromatogram is created by summing the intensities of all detected ions across a specified

Click Here to Buy book on Amazon

CHAPTER 23

Spectroscopy: UV, IR and Mass Spectroscopy

1. Which of the following statements correctly describes the nature of electromagnetic radiation?
(A) It consists of mutually perpendicular electric and magnetic fields oscillating parallel to the direction of propagation.
(B) It consists of oscillating electric and magnetic fields that are perpendicular to each other and to the direction of propagation.
(C) It requires a physical medium to propagate through space.
(D) It is composed exclusively of longitudinal waves traveling at the speed of sound.

2. According to the Beer-Lambert law, what is the relationship between the absorbance of a solution and its transmittance?
(A) Absorbance is directly proportional to transmittance.
(B) Absorbance is the natural logarithm of transmittance.
(C) Absorbance is the inverse of transmittance.
(D) Absorbance is the negative base-10 logarithm of transmittance.

3. Consider the following regions of the electromagnetic spectrum:
1. Microwave
2. X-ray
3. Ultraviolet
4. Infrared

Arrange the regions in increasing order of their energy and select the correct option:
(A) 1, 4, 3, 2
(B) 2, 3, 4, 1
(C) 4, 1, 3, 2
(D) 1, 3, 4, 2

4. Which of the following is considered a chemical deviation from the Beer-Lambert law?
(A) Stray light reaching the detector.
(B) Polychromatic radiation emitted by the source.
(C) Association, dissociation, or reaction of the absorbing analyte molecules.
(D) Mismatched cuvettes during measurement.

5. In UV-Visible spectroscopy, which type of electronic transition typically requires the least amount of energy?
(A) n to pi*
(B) Sigma to sigma*
(C) Pi to pi*
(D) n to sigma*

6. Consider the following statements regarding the deviations from the Beer-Lambert law:
I. Positive or negative deviations can occur at high analyte concentrations due to electrostatic interactions.
II. Instrumental deviations primarily occur due to the use of perfectly monochromatic light.
III. Changes in the refractive index of the solution at high concentrations can cause deviations.

Which of the above statements are correct?
(A) I and II
(B) I and III
(C) II and III
(D) I, II, and III

NODIA

7. A functional group that does not absorb in the UV-Vis region itself but can increase the wavelength and intensity of absorption when attached to a chromophore is known as:
(A) A fluorophore
(B) An auxochrome
(C) A luminophore
(D) An isotope

8. In UV-Visible spectroscopy, a shift of the absorption maximum towards a longer wavelength is termed as:
(A) Hypsochromic shift
(B) Hyperchromic shift
(C) Bathochromic shift
(D) Hypochromic shift

packed with sub-2-micron particles. Smaller particles significantly decrease C-term mass transfer resistance and A-term eddy diffusion in the Van Deemter equation, maintaining low plate height and high theoretical plate counts even at elevated mobile phase linear velocities.

49. (B) Electrospray Ionization (ESI)
Electrospray Ionization is a soft atmospheric pressure ionization interface extensively used to couple liquid chromatography with mass spectrometry. High voltage applied to a capillary tip aerosolizes eluting liquid mobile phase into charged droplets. Solvents evaporate to generate gas-phase ions from polar, non-volatile, and thermally labile toxicological analytes without inducing extensive thermal degradation.

50. (D) Area or height of the peak
In quantitative chromatographic analysis, detector signal response is directly proportional to solute mass or concentration passing through the detector flow cell. Measuring chromatographic peak area or peak height allows construction of precise calibration curves against known reference standards, enabling accurate and reproducible determination of unknown analyte concentrations in targeted sample extracts.

51. (A) A known compound added in equal amounts to all samples and standards.
An internal standard is a chemical compound added in a fixed, constant concentration to all calibration standards, quality control samples, and unknown specimens prior to analysis. It accounts for potential sample losses during preparation, volume variations, injection volume fluctuations, and instrument drift by using the peak area ratio of analyte to internal standard for quantification.

52. (C) I, II, IV, III
Quantitative drug analysis via liquid chromatography follows a systematic analytical workflow. First, reference standards are prepared to construct a calibration curve. Second, target drugs are extracted from biological matrices like blood or urine. Third, prepared extracts are injected into the liquid chromatograph. Finally, peak areas are plotted against calibration curves to calculate unknown drug concentrations.

53. (A) Matrix-induced ion suppression or enhancement
Matrix-induced ion suppression or enhancement occurs when co-eluting matrix components interfere with droplet charge evaporation or ion formation in electrospray ionization sources during liquid chromatography-mass spectrometry. This matrix effect severely alters analyte ionization efficiency, compromising quantitative accuracy and analytical precision unless compensated for by rigorous sample cleanup or stable-isotope-labeled internal standards.

54. (D) They are thermally labile and decompose in hot GC injectors.
High explosives such as RDX and HMX are thermally labile nitramines that readily undergo rapid thermal decomposition at high temperatures encountered inside gas chromatography injection ports and heated columns. High Performance Liquid Chromatography operates at ambient or low temperatures, providing a gentle separation environment that prevents chemical thermal degradation during explosive analysis.

55. (B) P-4, Q-3, R-1, S-2
Forensic evidence types mandate specific chromatographic techniques. Gas chromatography-mass spectrometry is ideal for volatile ignitable liquid residues. High performance liquid chromatography effectively separates thermally unstable designer drugs without heat degradation. Thin layer chromatography serves for preliminary ink analysis. Pyrolysis gas chromatography decomposes insoluble automotive paint chips to reveal distinct polymeric fingerprint pyrograms.

56. (C) Clean up the sample matrix and concentrate the analytes.
Solid Phase Extraction is a sample preparation technique that utilizes packed sorbent cartridges to isolate target analytes from complex biological or environmental matrices. Unwanted matrix interferents are washed away while target solutes are retained on the sorbent. Subsequent elution yields a cleaned, concentrated sample extract, improving chromatographic performance and mass spectrometry sensitivity.

57. (D) Greater than 1.0
Peak tailing occurs when the back half of a chromatographic peak elutes more slowly than the front half, creating an asymmetric elongated

Downloaded from www.pdf.tube

76. (B) The mobile phase entering the column
In liquid chromatography terminology, the mobile phase solvent liquid delivered into the inlet of the analytical column is defined as the eluent. As this carrier solvent travels through the column packing and exits carrying separated analytes toward the detector, the exiting mobile phase liquid stream is referred to as the eluate.

77. (A) P-3, Q-1, R-4, S-2
Liquid chromatography modes feature distinct phase setups. Normal phase LC employs a non-polar mobile phase less polar than the stationary phase. Reversed phase LC utilizes a mobile phase more polar than the stationary phase. Ion exchange LC relies on charged ionic resins. Size exclusion LC uses porous gel beads where smaller molecules penetrate pores and elute later.

78. (C) Improves reproducibility of injection volumes and retention times.
Autosamplers in automated gas chromatography systems automate sample introduction, eliminating manual human syringe injection variability. By delivering precise micro-volumes with controlled speed and plunger motion, autosamplers dramatically enhance quantitative analytical precision, improve peak area repeatability, minimize retention time variations, and enable continuous, unattended round-the-clock laboratory analysis of large sample batches.

79. (B) 0.5
The retention factor in thin layer chromatography is calculated as the ratio of solute migration distance to solvent front migration distance from the baseline. Dividing the dye spot migration distance of 4 cm by the total solvent front distance of 8 cm yields an Rf value of $4 / 8 = 0.5$.

80. (C) Biomolecules like enzymes, antibodies, or DNA
Affinity chromatography is a bio-specific separation method exploiting highly specific biological binding interactions between a target macromolecule and a ligand immobilized on a solid support matrix. This technique is predominantly used in biochemistry and molecular biology to isolate and purify proteins, antibodies, enzymes, antigens, and nucleic acids from complex biological extracts.

81. (B) I and III are correct
Coupling gas chromatography to mass spectrometry requires transferring eluting gaseous analytes from atmospheric column exit pressure into the high-vacuum ion source of the mass spectrometer. Helium serves as ideal carrier gas because its low atomic mass permits efficient evacuation by high-vacuum pumps. Gaseous analytes remain in vapor phase without liquid conversion.

82. (D) Whatman filter paper (pure cellulose)
Whatman filter paper composed of pure high-grade alpha-cellulose fibers is the standard stationary support medium in paper chromatography. Cellulose polymers contain abundant hydrophilic hydroxyl groups that readily trap atmospheric moisture. The trapped water acts as the immobilized stationary liquid phase, while mobile solvent moves up the cellulose sheet via capillary action.

83. (A) Purge and trap dynamic headspace
Purge and trap dynamic headspace is a sample extraction technique used to isolate trace volatile organic compounds from solid or aqueous matrices. An inert purge gas bubbles through or sweeps across heated sample matrices, stripping volatile solutes into a sorbent trap. The trap is subsequently flash-heated to desorb volatiles directly into a gas chromatograph.

NODIA

84. (C) Flame Ionization Detector (FID)
The Flame Ionization Detector is considered a destructive detector because eluting sample analytes exiting the chromatographic column are introduced directly into a high-temperature hydrogen-air flame. The flame pyrolyzes and combusts sample molecules to generate ions, chemically altering and destroying the analytes, preventing downstream fraction collection or secondary detection by non-destructive detectors.

85. (A) Maintain solvent vapour saturation for uniform capillary rise.
Keeping thin layer chromatography development chambers tightly sealed ensures the internal atmosphere becomes fully saturated with solvent vapor. Vapour saturation prevents mobile phase evaporation from the plate surface during development. Uncontrolled evaporation alters mobile phase composition, produces uneven capillary solvent fronts, causes edge effects, and leads to irreproducible retention factor values.

67. (A) Co-elution
Co-elution occurs in chromatography when two or more distinct chemical constituents elute simultaneously from the column at the exact same retention time. This results in overlapping peak profiles on the chromatogram, masking true component peak areas and requiring column stationary phase modifications, temperature program adjustments, or mobile phase optimization to achieve individual peak separation.

68. (C) I, II, and IV are correct
The Nitrogen Phosphorus Detector, also designated Thermionic Specific Detector, incorporates a electrically heated ceramic bead containing rubidium or cesium salts. The bead selectively promotes catalytic thermionic ionization of nitrogen and phosphorus-containing organic molecules. Because NPD exhibits minimal response toward non-nitrogenous hydrocarbons, it is widely utilized for detecting nitrogenous drugs and organophosphate pesticides.

69. (A) Decreased retention times for all analytes
In reversed-phase liquid chromatography, the stationary phase is non-polar and the mobile phase is aqueous-organic. Increasing organic solvent proportion increases overall mobile phase elution strength and decreases mobile phase polarity. Consequently, organic analytes partition more readily into the moving organic mobile phase, leading to reduced retention times across all eluting target analytes.

70. (C) 1.5
In chromatographic analytical chemistry, complete baseline resolution between two adjacent peaks is formally achieved when the calculated chromatographic resolution value equals or exceeds 1.5. At a resolution value of 1.5, overlap between adjacent peak profiles drops below 0.3 percent, allowing complete physical separation and highly accurate individual quantitative peak area integration.

71. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Silylating reagents like BSTFA are widely used in gas chromatography to derivatize polar compounds containing active hydrogen atoms, such as sugars, carboxylic acids, and hydroxylated drugs. Replacing polar functional hydrogens with trimethylsilyl groups significantly lowers hydrogen bonding capability, decreases compound polarity, enhances thermal stability, and increases volatility for optimal column separation.

72. (C) Screening and quantifying synthetic cannabinoids and opiates.
Liquid chromatography-mass spectrometry is a crucial analytical platform in forensic toxicology for screening and quantifying polar, non-volatile, or thermally labile substances in biological fluids. It enables detection of modern synthetic cannabinoids, designer opioids, and drug metabolites in urine, blood, or oral fluid with extreme sensitivity, low detection limits, and high specificity.

73. (D) Isolate and collect purified compounds for further use.
Unlike analytical chromatography which aims to identify or quantify mixture constituents using trace injection volumes, preparative chromatography focuses on purifying and harvesting chemical species. Preparative systems utilize larger columns, higher sample loading capacities, and automated fraction collectors to isolate pure target compounds for subsequent synthesis, pharmacological testing, or structural characterization.

74. (A) Molecules separate via electrostatic interaction with charged stationary groups.
Ion exchange chromatography separates ionic and ionizable molecules based on reversible electrostatic interactions with oppositely charged functional groups covalently bound to a solid stationary matrix. Cation exchange resins retain positively charged cations, whereas anion exchange resins attract negatively charged anions. Solutes are selectively eluted by altering mobile phase ionic strength or pH.

75. (B) Time and Detector Response (e.g., mAU)
A liquid chromatogram displays detector output as a continuous graph function. The horizontal x-axis represents elapsed time in minutes from sample injection, depicting retention times of eluting components. The vertical y-axis measures detector response intensity, expressed in units such as milli-absorbance units or millivolts, proportional to solute concentration in detector effluent.

Click Here to Buy book on Flipkart

right tail. Peak asymmetry factor is calculated by measuring the ratio of the rear distance to the front distance at 10 percent peak height. A tailing peak yields an asymmetry factor value greater than 1.0.

58. (A) Distinguished from background noise at a 3:1 signal-to-noise ratio.
Limit of Detection represents the lowest concentration of an analyte in a sample matrix that can be reliably distinguished from baseline background noise, typically defined at a signal-to-noise ratio of 3:1. While LOD confirms analyte presence with high statistical confidence, it differs from Limit of Quantitation, which requires a 10:1 signal-to-noise ratio.

59. (B) Headspace SPME or heated headspace extraction
In arson investigations, fire debris samples containing ignitable liquid residues are extracted using headspace sampling methods such as Solid Phase Microextraction or heated passive headspace extraction. Heating fire debris volatilizes ignitable hydrocarbons into the container headspace, where they are selectively adsorbed onto SPME fibers or carbon strips, avoiding extraction of heavy matrix background interference.

60. (B) I, II, and III all affect separation.
Gas chromatographic separation efficiency in capillary columns depends directly on column internal diameter, stationary phase film thickness, and carrier gas flow rate. Internal diameter dictates linear velocity and resistance to mass transfer, film thickness influences sample capacity and retention factor, while carrier gas flow rate determines linear velocity, directly influencing Van Deemter plate height.

61. (A) $k = (t_r - t_0) / t_0$
The Retention Factor, also termed capacity factor, measures the relative retention of a sample solute in a chromatographic column. It is mathematically calculated using the equation $k = (t_r - t_0) / t_0$ where tr represents analyte retention time and t_0 represents dead time required for an unretained solvent front to pass completely through the column.

62. (C) Presence of halogens like chlorine or fluorine
The Electron Capture Detector exhibits high sensitivity toward molecules containing electronegative functional groups that readily capture thermal electrons within the detector cell. Compounds substituted with halogen atoms such as chlorine, fluorine, bromine, or iodine absorb thermal electrons strongly, causing a measurable drop in standing current, making ECD ideal for halogenated pesticide analysis.

63. (D) Air bubbles form in the pump or detector, causing baseline noise.
In high performance liquid chromatography, mobile phase solvents must be degassed prior to use to remove dissolved atmospheric gases. Undegassed solvents under high system pressures release dissolved air microbubbles when transitioning to lower pressure detector flow cells. These bubbles disrupt pump check valve operation and cause erratic baseline spikes in optical detectors.

64. (C) Blood collection → Protein precipitation/ Extraction → LC separation → MS detection → Data interpretation
Analyzing drugs in blood samples by LC-MS requires a logical analytical workflow. First, blood is collected. Second, sample preparation involves protein precipitation or extraction to isolate target drug analytes. Third, clean extracts undergo LC separation. Fourth, separated solutes enter the mass spectrometer for detection. Finally, collected mass spectral data undergo interpretation.

65. (B) Wall-Coated Open Tubular
The abbreviation WCOT stands for Wall-Coated Open Tubular, a primary column geometry in gas chromatography. In WCOT capillary columns, a thin liquid stationary phase film is coated directly onto the inside fused silica wall, leaving an open central flow path. This structure yields low flow resistance, high efficiency, and superior peak resolution.

66. (D) Inject precise sample volumes into high-pressure flow without stopping it.
A six-port Rheodyne injection valve is standard hardware in high performance liquid chromatography systems. It features a fixed sample loop and rotary switching positions that allow precise sample loading at ambient pressure, followed by rapid switching to inject the sample directly into high-pressure mobile phase stream without interrupting continuous solvent flow.

NODIA

86. (D) Higher sample loading capacity
Capillary columns offer superior separation efficiency, faster analytical run times, and enhanced resolution compared to packed columns in gas chromatography. However, because capillary columns possess extremely thin stationary phase films and narrow internal diameters, their total sample loading capacity is significantly lower than packed columns, making capillary columns susceptible to peak overloading.

87. (B) The mobile phase volume inside the column excluding stationary phase.
In liquid chromatography, column void volume, or dead volume, represents the total volume of mobile phase contained within the column internal space not occupied by solid stationary phase packing particles. It corresponds to the volume of mobile phase required to transport an unretained solute from column inlet to detector output.

88. (C) Standard mass spectral library (NIST/ SWGDRUG)
Definitive identification of unknown organic chemical compounds in gas chromatography-mass spectrometry is accomplished by comparing experimental mass spectra against established standardized mass spectral reference libraries, such as NIST or SWGDRUG. Spectral matching algorithms evaluate fragment ion mass-to-charge ratios and relative ion abundance patterns to achieve highly confident qualitative compound identification.

89. (D) Stationary phase degradation and elution at high temperatures.
Column bleed in gas chromatography refers to the slow, continuous thermal degradation and elution of stationary phase polymer fragments from open tubular capillary columns at high oven operating temperatures. Column bleed elevates baseline signal noise, produces ghost peaks, alters mass spectra, and gradually degrades column separation performance over prolonged high-temperature use.

90. (A) Polar solvent mixture with methanol or ethyl acetate
In normal phase thin layer chromatography, the stationary phase is strongly polar bare silica. To develop highly polar analytes, the mobile phase must contain polar organic solvents such as methanol or ethyl acetate. Polar solvent molecules compete effectively for active silica adsorption sites, displacing polar solutes and promoting elution up the plate.

www.nodia.in

NODIA

mass range at each time point throughout the chromatographic run. The resulting plot displays total ion abundance on the vertical axis against retention time on the horizontal axis, revealing eluting component peaks.

40. (C) Non-volatile, thermally fragile, or highly polar
High Performance Liquid Chromatography operates entirely at ambient or controlled column temperatures without vaporizing samples. This makes liquid chromatography ideal for analyzing non-volatile, thermally labile, high-molecular-weight, or strongly polar substances—such as proteins, pharmaceuticals, explosives, and polar drug metabolites—that would thermally decompose or fail to volatilize inside gas chromatography injection systems.

41. (D) To protect the analytical column from particles and contaminants.
A guard column is a short protective column installed upstream of the main analytical column in liquid chromatography systems. It contains packing material similar to the analytical column and serves to trap microparticles, strongly retained impurities, and insoluble matrix components, thereby extending analytical column operational lifespan and preserving peak resolution.

42. (A) The most polar compounds
In reversed-phase liquid chromatography, the stationary phase consists of non-polar hydrophobic molecules, while the mobile phase is aqueous and polar. Analyte retention increases with increasing hydrophobicity. Highly polar compounds exhibit low affinity for non-polar stationary phase hydrocarbon chains, dissolving preferentially in the polar mobile phase and eluting first from the chromatographic column.

43. (B) C_{18} bonded silica
Octadecylsilane, commonly designated C_{18}, is the most widely utilized non-polar stationary phase in reversed-phase liquid chromatography. It consists of long eighteen-carbon hydrophobic alkyl chains covalently bonded to porous silica gel particles. This non-polar surface provides high hydrophobic retention, robust column stability, and excellent chromatographic resolution for diverse non-polar and moderately polar organic analytes.

44. (B) II and III
In high performance liquid chromatography, moving and introducing sample into the mobile phase requires a high-pressure pump and a injection valve like a Rheodyne injector. The high-pressure pump delivers mobile phase continuous flow against column resistance, while the Rheodyne loop injector enables precise introduction of liquid sample into pressurized flow.

45. (A) Isocratic elution
Isocratic elution refers to liquid chromatographic separations where mobile phase solvent composition remains completely constant throughout the entire operational run. This approach provides simple operational setup, stable baseline signals, and constant column equilibration. It is best suited for simple sample mixtures containing analytes with similar retention behaviors and chemical polarity profiles.

46. (C) Record full UV-Vis spectra of analytes simultaneously upon elution.
Photodiode Array detectors in liquid chromatography collect absorption data simultaneously across a broad wavelength spectrum during analyte elution. Unlike conventional single-wavelength detectors, photodiode array systems construct three-dimensional UV-Vis spectral maps, enabling automated spectral library matching, peak purity confirmation, and unambiguous qualitative identification of complex eluting solutes without repeating analytical runs.

47. (D) Fluorescence detector
Fluorescence detectors in liquid chromatography excite analyte molecules using specific shorter wavelengths of ultraviolet or visible light. Excited molecules undergo radiative decay, emitting light at longer wavelengths. Because fluorescence emission occurs against a low optical background, fluorescence detection yields exceptional sensitivity and selectivity for fluorescing compounds like polycyclic aromatic hydrocarbons and fluorescently labeled drugs.

48. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Ultra High Performance Liquid Chromatography achieves superior separation speed and resolution compared to standard HPLC by using columns

Downloaded from www.pdf.tube

9. Which of the following light sources is most commonly used for the ultraviolet region in a UV-Vis spectrophotometer?
(A) Tungsten-halogen filament lamp
(B) Nernst glower radiation source
(C) Hollow cathode discharge lamp
(D) Deuterium gas discharge lamp

10. Match List I with List II:
List I: Spectroscopic Shift
P. Bathochromic shift
Q. Hypsochromic shift
R. Hyperchromic shift
S. Hypochromic shift
List II: Description
1. Decrease in absorption intensity
2. Shift to shorter wavelength
3. Increase in absorption intensity
4. Shift to longer wavelength
Select the correct option:
(A) P-4, Q-2, R-3, S-1
(B) P-2, Q-4, R-1, S-3
(C) P-4, Q-2, R-1, S-3
(D) P-2, Q-4, R-3, S-1

11. What is the primary advantage of a double-beam UV-Vis spectrophotometer over a single-beam instrument?
(A) It utilizes a single universal optical cell to hold both the sample and reference solution simultaneously.
(B) It automatically compensates for real-time fluctuations in the light source intensity.
(C) It features a simplified internal optical arrangement that significantly reduces routine instrument maintenance.
(D) It completely eliminates the requirement for an optical dispersion element like a monochromator.

12. In forensic toxicology, UV-Visible spectrophotometry is primarily utilized as:
(A) A definitive confirmatory technique for resolving complex unknown biological mixtures.
(B) A screening tool for identifying drug classes and determining concentrations.
(C) A precision analytical method to determine the stable isotopic composition of poisons.
(D) A quantitative technique to analyze the trace elemental composition of gunshot residues.

13. Colorimetry operates primarily in which region of the electromagnetic spectrum?
(A) 200 - 400 nm
(B) 400 - 800 nm
(C) 800 - 2500 nm
(D) 2.5 - 15 micrometers

14. Infrared (IR) spectroscopy exploits the interaction of electromagnetic radiation with matter by measuring:
(A) The promotion of valence electrons from bonding to anti-bonding molecular orbitals.
(B) The high-energy ejection of tightly bound inner-shell electrons from target atoms.
(C) Changes in molecular vibrational and rotational energy states.
(D) The reversal of nuclear spin state orientations within an applied magnetic field.

15. The fingerprint region in an Infrared spectrum, which provides highly specific patterns for molecular identification, is typically found in the range of:
(A) 4000 to 2500 cm^{-1}
(B) 2500 to 1500 cm^{-1}
(C) 1500 to 400 cm^{-1}
(D) 400 to 10 cm^{-1}

16. Which specific molecular vibration generally requires a higher energy of absorption in IR spectroscopy?
(A) Symmetrical stretching
(B) In-plane bending (scissoring)
(C) Asymmetrical stretching
(D) Out-of-plane bending (twisting)

17. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Diatomic molecules like N_2 and O_2 do not show absorption bands in the infrared spectrum.
Reason (R): For a molecule to be IR active, there must be a net change in its dipole moment during the vibration.
In the light of the above statements, choose the correct answer from the options given below:
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(B) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

NODIA

18. In the IR spectrum, the characteristic absorption band for a carbonyl group (C=O) typically appears in which frequency range?
(A) 3200 - 3600 cm^{-1}
(B) 2100 - 2260 cm^{-1}
(C) 1650 - 1750 cm^{-1}
(D) 1000 - 1300 cm^{-1}

19. A major advantage of Fourier Transform Infrared (FTIR) spectroscopy over dispersive IR instruments is the "Fellgett's advantage," which refers to:
(A) Simultaneous measurement of all light wavelengths for rapid spectrum acquisition.
(B) Significantly higher optical throughput resulting from the total absence of entrance slits.
(C) Superior spectral resolution achieved through advanced high-density diffraction gratings.
(D) Complete elimination of instrument background noise via sample chemical derivatization.

20. Consider the following statements regarding FTIR spectroscopy:
I. It utilizes a Michelson interferometer to generate an interferogram.
II. A mathematical operation called Fourier transform converts the time-domain signal into a frequency-domain spectrum.
III. Dispersive elements like prisms and gratings are essential components of an FTIR spectrometer.
IV. It provides a higher signal-to-noise ratio compared to continuous-wave dispersive instruments.
Which of the above statements are correct?
(A) I, II, and III
(B) I, II, and IV
(C) II, III, and IV
(D) I, III, and IV

21. In sample preparation for solid analysis using transmission IR spectroscopy, the sample is frequently mixed and pressed into a transparent pellet using:
(A) Potassium bromide
(B) Calcium carbonate
(C) Sodium chloride
(D) Lithium fluoride

22. In Attenuated Total Reflectance (ATR) spectroscopy, the depth of penetration of the evanescent wave into the sample depends on:
(A) The average isotopic mass of the elemental constituents within the sample matrix.
(B) The overall mechanical thickness of the compressed alkali halide pellet used.
(C) The ambient operational temperature maintained inside the sample compartment.
(D) The refractive indices of the ATR crystal and sample.

23. Which core optical component is responsible for beam splitting in the Michelson interferometer of an FTIR instrument?
(A) Photomultiplier tube detector assembly
(B) Beam splitter
(C) Echelette reflection diffraction grating
(D) Hollow cathode gas discharge lamp

24. For analyzing trace evidence like a single layer of multi-layered automotive paint without complex sample preparation, which technique is most suitable?
(A) Flame Atomic Absorption Spectroscopy
(B) Colorimetry
(C) FTIR-ATR microscopy
(D) Gas Chromatography

25. Select the correct sequence of steps involved in processing an interferogram into a readable FTIR spectrum:
(A) Fourier Transform → Detector → Beam Splitter → Spectrum
(B) Beam Splitter → Detector → Interferogram → Fourier Transform → Spectrum
(C) Interferogram → Beam Splitter → Fourier Transform → Detector → Spectrum
(D) Detector → Fourier Transform → Beam Splitter → Interferogram → Spectrum

26. Raman spectroscopy is based on which of the following principles?
(A) Inelastic light scattering
(B) Elastic scattering of incident monochromatic light
(C) Resonant absorption of continuous polychromatic radiation
(D) Spontaneous light emission from thermally excited neutral atoms

27. In a Raman spectrum, lines occurring at lower frequencies (longer wavelengths) than the incident laser light are known as:

Click Here to Buy book on Amazon

(A) Rayleigh lines
(B) Stokes lines
(C) Anti-Stokes lines
(D) Isosbestic lines

28. Match List I with List II:
List I: Spectroscopic Technique
P. UV-Visible Spectroscopy
Q. IR Spectroscopy
R. Raman Spectroscopy
S. Mass Spectrometry
List II: Underlying Principle
1. Change in molecular polarizability
2. Gas-phase ion separation by m/z
3. Change in molecular dipole moment
4. Electronic excitation
Select the correct option:
(A) P-4, Q-3, R-1, S-2
(B) P-3, Q-4, R-2, S-1
(C) P-4, Q-1, R-3, S-2
(D) P-1, Q-3, R-4, S-2

29. According to the rule of mutual exclusion in spectroscopy, for a molecule possessing a center of symmetry:
(A) Vibrational modes that are IR active are Raman inactive, and vice versa.
(B) All vibrational modes are both IR and Raman active.
(C) No vibrational modes are either IR or Raman active.
(D) Only stretching vibrations are active; bending vibrations are completely inactive.

30. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Raman spectroscopy is highly advantageous for analyzing forensic samples stored in glass vials or aqueous solutions.
Reason (R): Water and glass produce very weak Raman signals and do not obscure the spectrum of the analyte.
In the light of the above statements, choose the correct answer from the options given below:
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(B) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

NODIA

31. Mass spectrometry separates ions based on which of the following physical properties?
(A) Effective atomic orbital radius
(B) Relative Pauling electronegativity
(C) First atomic ionization potential
(D) Mass-to-charge ratio

32. Which of the following is considered a "hard" ionization technique that typically produces extensive fragmentation in mass spectrometry?
(A) Electrospray Ionization (ESI)
(B) Matrix-Assisted Laser Desorption/Ionization (MALDI)
(C) Electron Impact (EI)
(D) Chemical Ionization (CI)

33. In Chemical Ionization (CI) mass spectrometry, a reagent gas is used to ionize the sample. Which of the following is commonly used as a reagent gas?
(A) Argon
(B) Methane
(C) Nitrogen
(D) Helium

34. Consider the following statements regarding MALDI in mass spectrometry:
I. It requires the sample to be co-crystallized with a UV-absorbing matrix.
II. It is a highly destructive technique that shatters large biomolecules into single atoms.
III. It is frequently coupled with a Time-of-Flight (TOF) mass analyzer.
Which of the above statements are correct?
(A) I and II
(B) I and III
(C) II and III
(D) I, II, and III

35. Electrospray Ionization (ESI) is an ideal ionization method for:
(A) Coupling with High-Performance Liquid Chromatography (HPLC).
(B) Analyzing volatile hydrocarbons directly from a solid sample.
(C) Generating atomic ions for trace elemental analysis of glass.
(D) Creating highly fragmented spectra for structural elucidation of small alkanes.

36. Consider the following fundamental components of a typical mass spectrometer:
1. Mass Analyzer
2. Ion Source

3. Detector
4. Sample Inlet

Select the correct functional order of these components:
(A) 4, 1, 2, 3
(B) 4, 2, 1, 3
(C) 2, 4, 1, 3
(D) 1, 2, 3, 4

37. Which mass analyzer uses a combination of oscillating radio-frequency (RF) and direct current (DC) electric fields applied to four parallel rods to separate ions?
(A) Quadrupole
(B) Magnetic Sector
(C) Time-of-Flight
(D) Ion Trap

38. In a Time-of-Flight (TOF) mass analyzer, the time required for an ion to reach the detector is:
(A) Inversely proportional to the total rest mass of the target ion.
(B) Directly proportional to the net valence electrostatic charge of the ion.
(C) Completely independent of both the nominal mass and charge state of the ion.
(D) Proportional to the square root of its m/z ratio.

39. An ion trap mass analyzer operates by:
(A) Accelerating produced ions through an elongated field-free straight flight tube using constant high voltage.
(B) Trapping ions in a 3D field and selectively ejecting them by m/z.
(C) Utilizing powerful electromagnets to continually bend the flight trajectory of focused ions.
(D) Directing streaming ions sequentially through a series of mechanical collimating slit apertures.

40. In a typical mass spectrum, the peak with the highest intensity, arbitrarily assigned a relative abundance of 100%, is termed the:
(A) Molecular ion peak
(B) Isotopic peak
(C) Base peak
(D) Fragment peak

41. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): In an electron impact (EI) mass spectrum, the molecular ion peak (M^+) provides the exact molecular weight of the compound.
Reason (R): The molecular ion is formed by the loss of a single electron from the intact neutral molecule.
In the light of the above statements, choose the correct answer from the options given below:
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(B) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

42. According to the Nitrogen Rule in mass spectrometry, an organic molecule with an odd nominal mass (assuming it contains only C, H, O, N, and halogens) must contain:
(A) An odd number of nitrogen atoms.
(B) An even number of nitrogen atoms.
(C) No nitrogen atoms.
(D) Only one nitrogen atom.

43. The McLafferty rearrangement is a specific fragmentation pattern in mass spectrometry commonly observed in compounds containing:
(A) Highly saturated unsubstituted monocyclic hydrocarbons
(B) A carbonyl group with a gamma-hydrogen.
(C) Extended unbranched straight-chain aliphatic alkanes
(D) Poly-substituted aromatic halogenated organic compounds

44. Match List I with List II:
List I: Element
P. Chlorine
Q. Bromine
R. Carbon
S. Sulfur
List II: Characteristic Isotopic Peak Signature in MS
1. M+2 peak approximately 4% the intensity of M^+
2. M+2 peak approximately 33% the intensity of M^+
3. M+2 peak approximately 100% the intensity of M^+ (1:1 ratio)
4. M+1 peak approximately 1.1% the intensity of M^+ per atom

Select the correct option:
(A) P-2, Q-3, R-4, S-1

Downloaded from www.pdf.tube

(B) P-3, Q-2, R-1, S-4
(C) P-2, Q-3, R-1, S-4
(D) P-3, Q-1, R-4, S-2

45. Tandem mass spectrometry (MS/MS) is a technique that involves:
(A) Two sequential mass analysis stages separated by ion fragmentation.
(B) Operating two distinct physical ionization sources simultaneously within a single mass spectrometer chamber.
(C) Direct physical coupling of a gas chromatograph and liquid chromatograph to a shared single detector module.
(D) Continuously matching recorded sample spectra against a comprehensive reference library database in real time.

46. Atomic Absorption Spectroscopy (AAS) is primarily based on the absorption of light by:
(A) Excited ions in a plasma state.
(B) Diatomic molecules in a gaseous state.
(C) Free, neutral atoms in their ground state.
(D) Solid particulate matter suspended in a flame.

47. Which specific light source is almost exclusively used in Atomic Absorption Spectroscopy to provide the narrow emission lines required for analysis?
(A) Nernst glower IR source
(B) Deuterium arc discharge lamp
(C) High-pressure xenon arc lamp
(D) Hollow cathode lamp

48. Consider the following statements regarding Atomic Spectroscopy:
I. In AAS, a hollow cathode lamp specific to the target element is required.
II. ICP-AES measures the light emitted by excited atoms and ions as they return to lower energy states.
III. ICP-AES allows for simultaneous multi-element analysis.
IV. Graphite furnace AAS generally offers poorer detection limits compared to flame AAS.
Which of the above statements are correct?
(A) I, II, and III
(B) I, III, and IV
(C) II, III, and IV
(D) I, II, and IV

49. In Inductively Coupled Plasma (ICP) spectroscopy, the plasma is typically generated using which highly purified gas?
(A) Nitrogen
(B) Argon
(C) Helium
(D) Hydrogen

50. The typical operating temperature of an Argon ICP plasma ranges approximately between:
(A) 500 to 1,000 K
(B) 2,000 to 4,000 K
(C) 6,000 to 10,000 K
(D) 15,000 to 20,000 K

51. Which analytical technique combines the high-temperature ionization capabilities of a plasma source with the sensitive detection of a mass analyzer for ultra-trace elemental profiling?
(A) ICP-MS
(B) ICP-AES
(C) GC-MS
(D) FTIR-ATR

52. Neutron Activation Analysis (NAA) measures the concentration of elements by bombarding the sample with neutrons and analyzing the resultant emission of:
(A) Alpha particles
(B) Beta particles
(C) Gamma rays
(D) X-rays

53. Consider the following statements regarding Neutron Activation Analysis (NAA) in forensic science:
I. It is generally a non-destructive analytical technique.
II. It requires access to a nuclear reactor or a strong neutron source.
III. It can determine the chemical state (oxidation state) of the elements in the sample.
Which of the above statements are correct?
(A) I and II
(B) I and III
(C) II and III
(D) I, II, and III

NODIA

54. X-ray fluorescence (XRF) spectroscopy operates on the principle of:
(A) Coherent elastic diffraction of monochromatic primary X-rays by the periodic crystal lattice of the solid sample matrix.
(B) Precise measurement of the critical angle

(A) Passing visible light through a diffraction grating.
(B) Bombarding a metal target (e.g., Copper) with high-energy electrons.
(C) Heating a tungsten filament to extremely high temperatures until it glows.
(D) Exposing a sample to a strong magnetic field.

72. Which of the following issues introduces stray light into a spectrophotometer, causing an instrumental deviation from the Beer-Lambert law?
(A) Operating at excessively high molar analyte concentrations beyond the linear dynamic range.
(B) Dynamic concentration-dependent chemical equilibrium shifts occurring within the sample solution.
(C) Scattering of light by dust or optical imperfections.
(D) Selecting and utilizing an inappropriate electronic detector type for the target wavelength.

73. A forensic toxicologist is estimating the blood alcohol concentration (BAC) using an enzymatic method coupled with UV spectroscopy. The conversion of NAD^+ to NADH is monitored. At what specific wavelength does NADH strongly absorb, allowing for this measurement?
(A) 260 nm
(B) 280 nm
(C) 340 nm
(D) 450 nm

74. An isosbestic point in UV-Vis spectroscopy indicates:
(A) A wavelength where two equilibrium species share identical molar absorptivity.
(B) The exact operational point at which the optical photosensor detector becomes fully saturated.
(C) The characteristic maximum wavelength of light absorption unique to a completely pure single substance.
(D) The specific optical wavelength at which background stray light completely cancels the analytical signal.

75. In molecular vibrations observed via IR spectroscopy, scissoring, rocking, wagging, and twisting are subclasses of:
(A) Stretching vibrations
(B) Bending vibrations
(C) Electronic transitions
(D) Rotational transitions

76. In an IR spectrum, a broad and strong absorption band typically appearing between 3200 cm^{-1} and 3600 cm^{-1} is strongly indicative of which functional group?
(A) Alkyne C-H stretch
(B) Carbonyl C=O stretch
(C) Hydroxyl O-H stretch
(D) Nitrile C≡N stretch

77. The ability of a mass spectrometer to separate two closely spaced ion peaks (e.g., mass 500.00 and 500.05) is defined as its:
(A) Resolving power
(B) Sensitivity
(C) Limit of detection
(D) Mass range

78. Which of the following best defines "soft ionization" in mass spectrometry?
(A) It efficiently transfers the solid sample into a neutral gaseous state without imparting any net electrical charge.
(B) It utilizes an extremely low electrical accelerating voltage potential across the electrostatic flight tube analyzer.
(C) It imparts minimal residual energy, yielding intact molecular ions with little fragmentation.
(D) It employs high-frequency acoustic sound waves rather than dynamic electric fields to separate mass ions.

79. Which of the following types of organic compounds typically forms the most stable and prominent molecular ion peak (M^+) under electron impact (EI) mass spectrometry?
(A) Straight-chain alkanes
(B) Highly branched alkanes
(C) Aliphatic alcohols
(D) Aromatic compounds

80. A compound contains one atom of an unknown halogen. The mass spectrum displays an M^+ peak and an M+2 peak with a relative intensity ratio of roughly 3:1. The halogen present is most likely:
(A) Fluorine
(B) Bromine
(C) Chlorine
(D) Iodine

Click Here to Buy book on Flipkart

bonds.
(D) Optimal operational efficiency limited exclusively to purely black, highly light-absorbing solid powder samples.

62. Which detector is most commonly used in routine benchtop GC-MS systems to amplify the ion signal?
(A) Photomultiplier tube
(B) Faraday cup
(C) Electron multiplier
(D) Thermal conductivity detector

63. A shift in the maximum absorption wavelength due to a change in solvent polarity is known as the solvent effect. A blue shift caused by this effect is termed a:
(A) Bathochromic shift
(B) Hyperchromic shift
(C) Auxochromic shift
(D) Hypsochromic shift

64. Consider the following statements regarding mass spectrometry ionization techniques:
I. MALDI is considered a soft ionization technique.
II. ESI is frequently used for large, non-volatile biomolecules.
III. Electron impact (EI) usually provides a clear, strong molecular ion peak for highly branched alkanes.
IV. Chemical Ionization operates at a much higher pressure in the source region than EI.
Which of the above statements is/are incorrect?
(A) I and II only
(B) III only
(C) II and IV only
(D) III and IV only

65. The primary purpose of a monochromator in a dispersive UV-Vis spectrophotometer is to:
(A) Convert the incident optical light beam directly into measurable analog electrical signals.
(B) Isolate a narrow wavelength band from polychromatic light.
(C) Split the single incoming light beam into equal sample and reference optical paths.
(D) Optically amplify the overall physical photon intensity of the transmitted light beam.

66. The Globar source, commonly used in IR spectroscopy, is primarily composed of:
(A) Tungsten filament
(B) Zirconium oxide
(C) Copper hollow cathode
(D) Silicon carbide

67. Consider the following statements regarding the differences between Raman and IR spectroscopy:
I. IR absorption requires a change in dipole moment, while Raman scattering requires a change in polarizability.
II. Sample preparation is generally much simpler for Raman spectroscopy.
III. Water is a strong interferent in Raman spectroscopy but is completely invisible in IR spectroscopy.
Which of the above statements are correct?
(A) I and II
(B) II and III
(C) I and III
(D) I, II, and III

68. In Atomic Absorption Spectroscopy (AAS), the formation of refractory compounds (like calcium phosphate) in the flame that resist atomization is an example of:
(A) Spectral interference
(B) Ionization interference
(C) Chemical interference
(D) Matrix interference

69. When coupling a Gas Chromatograph to a Mass Spectrometer (GC-MS), an interface is necessary primarily to:
(A) Remove carrier gas and lower pressure before entering the mass spectrometer.
(B) Efficiently convert the high-pressure liquid mobile phase stream completely into a neutral carrier gas.
(C) Rapidly condense all eluting separated analytes into a crystallized solid matrix suitable for MALDI analysis.
(D) Chemically derivatize volatile organic analytes in real time to enable sensitive flame ionization detection.

70. In the forensic analysis of gunshot residue (GSR) using ICP-MS, an examiner typically looks for the trace elemental combination of:
(A) Carbon, Nitrogen, and Oxygen
(B) Iron, Copper, and Zinc
(C) Arsenic, Thallium, and Mercury
(D) Lead, Barium, and Antimony

71. X-rays in an X-ray tube for XRD analysis are generated by:

Downloaded from www.pdf.tube

9. (D) Deuterium gas discharge lamp
A deuterium gas discharge lamp provides a continuous and intense emission spectrum spanning the ultraviolet region from approximately 190 to 400 nanometers. Electrical excitation of deuterium gas produces a continuous molecular radiation beam ideal for UV spectrophotometry. In contrast, tungsten-halogen lamps are predominantly utilized for the visible spectrum range due to their longer wavelength emissions.

10. (A) P-4, Q-2, R-3, S-1
Spectroscopic shifts describe changes in absorption wavelength and intensity in absorption spectra. A bathochromic shift corresponds to a movement toward longer wavelengths, whereas a hypsochromic shift indicates a movement toward shorter wavelengths. A hyperchromic shift represents an increase in absorption intensity, while a hypochromic shift signifies a decrease in overall absorption intensity, matching P-4, Q-2, R-3, and S-1.

11. (B) It automatically compensates for real-time fluctuations in the light source intensity.
A double-beam UV-Vis spectrophotometer splits light into two separate paths, passing through the sample cell and reference cell simultaneously. By continuously monitoring and comparing both optical beams, the instrument automatically compensates for real-time fluctuations in light source intensity, detector drift, and solvent background absorption. This yields superior signal stability and operational precision over single-beam configurations.

12. (B) A screening tool for identifying drug classes and determining concentrations.
In forensic toxicology, UV-Visible spectrophotometry serves predominantly as a rapid preliminary screening method rather than a definitive confirmatory technique. It allows analysts to detect broad classes of absorbing compounds, such as illicit drugs or poisons, and quantify their concentrations in biological fluids. Definitive confirmation typically requires hyphenated chromatographic methods coupled with mass spectrometry.

13. (B) 400 - 800 nm
Colorimetry measures the light absorption of colored chemical solutions specifically within the visible spectrum of electromagnetic radiation. The human visible light spectrum ranges from approximately 400 nanometers to 800 nanometers wavelength. By measuring light transmittance at specific visible wavelengths, colorimetric methods enable quantitative determination of concentration based on color intensity produced by chemical chromophores.

14. (C) Changes in molecular vibrational and rotational energy states.
Infrared spectroscopy measures the interaction of infrared light with molecules by measuring transitions between vibrational and quantized rotational energy levels. Absorption of infrared radiation occurs when the frequency of incident radiation matches the natural vibrational frequency of covalent bonds, inducing bond stretching and bending modes while requiring net changes in molecular dipole moment.

15. (C) 1500 to 400 cm^{-1}
The fingerprint region in infrared spectroscopy spans the wavenumber range between 1500 and 400 reciprocal centimeters. This spectral area contains complex, highly specific absorption patterns involving single-bond stretching and complex bending modes unique to each organic compound. Matching these intricate spectral signatures allows definitive chemical identification and discrimination between closely related molecular structures.

16. (C) Asymmetrical stretching
Molecular vibrations in infrared spectroscopy require varying amounts of energy depending on bond deformation dynamics. Stretching vibrations alter interatomic distances along the bond axis and require higher energy than bending vibrations. Among stretching modes, asymmetrical stretching involves opposing atomic movements that cause greater instantaneous dipole changes, thereby absorbing higher infrared energy frequencies than symmetrical stretching.

NODIA

17. (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
For a molecular vibration to absorb infrared radiation, the molecular vibration must produce a net change in the molecule's electric dipole moment. Homonuclear diatomic molecules such as nitrogen and oxygen possess completely symmetrical electron distributions. Since their stretching vibrations preserve zero dipole

81. To scan across different masses in a quadrupole mass analyzer, the instrument progressively varies:
(A) The physical effective length of the flight drift tube within the analyzer assembly.
(B) The applied DC and RF voltage magnitudes at a constant ratio.
(C) The overall magnetic field intensity produced by a permanent focal electromagnet.
(D) The static pressure level of the inert carrier gas contained inside the mass analyzer.

82. Which type of mass analyzer utilizes a curved flight tube placed within a strong magnetic field to deflect ions based on their momentum?
(A) Linear time-of-flight analyzer
(B) Radiofrequency quadrupole analyzer
(C) Electrostatic orbitrap analyzer
(D) Magnetic sector analyzer

83. In Atomic Absorption Spectroscopy, the Zeeman effect is frequently utilized for:
(A) Background correction for broad band molecular absorption interference.
(B) Thermally increasing the operational combustion temperature achieved within the flame cell.
(C) Rapidly atomizing solid powdered sample matrices directly without prior chemical acid dissolution.
(D) Effectively preventing the undesired thermal ionization of easily ionizable alkali metals in flame.

84. The device used to introduce the sample solution as a fine mist into the flame or plasma in atomic spectroscopy is called a:
(A) Photomultiplier
(B) Chopper
(C) Nebulizer
(D) Monochromator

85. In X-ray emission terminology, an X-ray photon emitted when an electron drops from the L shell to a vacancy in the K shell is designated as a:
(A) K-alpha (Kα) X-ray
(B) K-beta (Kβ) X-ray
(C) L-alpha (Lα) X-ray
(D) Bremsstrahlung X-ray

86. In quantitative forensic analysis using spectroscopy, the lowest concentration of an analyte that can be reliably distinguished from the background noise, but not necessarily quantified with precision, is known as the:
(A) Limit of Quantitation (LOQ)
(B) Dynamic Range
(C) Linear Range
(D) Limit of Detection (LOD)

87. Which of the following spectroscopic techniques is generally considered impractical for small, regional forensic science laboratories due to the strict requirement of accessing a nuclear reactor?
(A) ICP-Mass Spectrometry
(B) Neutron Activation Analysis
(C) Fourier Transform Infrared Spectroscopy
(D) Energy Dispersive X-ray Fluorescence

88. A major forensic advantage of utilizing X-ray Fluorescence (XRF) over Inductively Coupled Plasma Mass Spectrometry (ICP-MS) for elemental analysis of a suspect's metal tool is that XRF:
(A) Provides far lower limits of detection (in parts per trillion).
(B) Can distinguish between different isotopes of a metal.
(C) Is inherently a non-destructive analytical technique.
(D) Directly identifies the exact manufacturer of the tool.

89. In forensic toxicology, which hyphenated technique is widely considered the "gold standard" for the definitive confirmation and structural identification of unknown drugs of abuse in biological fluids?
(A) Thin Layer Chromatography (TLC)
(B) UV-Visible Spectrophotometry
(C) Flame Atomic Absorption Spectroscopy (FAAS)
(D) Gas Chromatography-Mass Spectrometry (GC-MS)

90. Which of the following is a primary distinction between MALDI and ESI as soft ionization techniques in mass spectrometry?
(A) MALDI ionizes from a solid matrix phase, while ESI ionizes from a liquid phase.
(B) MALDI exclusively utilizes a high-pressure reagent gas, whereas ESI relies entirely on a focused laser beam.
(C) MALDI always produces extensive diagnostic fragmentations, whereas ESI consistently produces no fragment ions.
(D) MALDI can only be coupled with a

Click Here to Buy book on Amazon

at which incident soft X-rays undergo total external reflection from a flat surface.
(C) High-temperature formation of an inductively coupled plasma state that emits high-energy continuous spectrum X-rays.
(D) Absorption of primary X-rays followed by emission of characteristic secondary X-rays.

55. Select the correct sequence of events occurring during X-ray fluorescence (XRF) analysis:
(A) Emission of secondary X-ray → Ejection of inner-shell electron → Incident primary X-ray → Outer-shell electron transition.
(B) Incident primary X-ray → Ejection of inner-shell electron → Outer-shell electron transition → Emission of secondary X-ray.
(C) Ejection of inner-shell electron → Emission of secondary X-ray → Incident primary X-ray → Outer-shell electron transition.
(D) Incident primary X-ray → Emission of secondary X-ray → Ejection of inner-shell electron → Outer-shell electron transition.

56. X-ray Diffraction (XRD) is based on the constructive interference of monochromatic X-rays diffracted by crystalline materials. This principle is mathematically expressed by:
(A) Beer-Lambert Law
(B) Snell's Law
(C) Bragg's Law
(D) Rayleigh Criterion

57. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): X-ray diffraction (XRD) is highly effective for identifying the specific chemical compounds (phases) present in a mixed powder like soil or explosives.
Reason (R): XRD relies on the unique crystal lattice spacing of compounds, allowing it to distinguish between polymorphs.
In the light of the above statements, choose the correct answer from the options given below:
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(B) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

58. Match List I with List II:
List I: Forensic Evidence
P. Determining the crystal phase of a suspected explosive powder
Q. Elemental profiling of a tiny glass fragment non-destructively
R. Detection of trace heavy metals in a hair sample
S. Identification of organic binder in a paint chip
List II: Preferred Spectroscopic Technique
1. Micro-XRF
2. ICP-MS
3. XRD
4. FTIR Microscopy
Select the correct option:
(A) P-3, Q-1, R-2, S-4
(B) P-1, Q-3, R-2, S-4
(C) P-3, Q-2, R-1, S-4
(D) P-2, Q-1, R-4, S-3

59. Compared to ICP-AES, Inductively Coupled Plasma Mass Spectrometry (ICP-MS) generally offers:
(A) Superior analytical spectral resolution specifically tailored for organic functional group identification.
(B) Higher sensitivity and ability to measure isotopic ratios.
(C) Significantly lower elemental sensitivity and higher practical limits of quantitative detection.
(D) Enhanced field portability designed specifically for rapid on-site crime scene evidence deployment.

NODIA

60. In the interpretation of a mass spectrum, an isotopic peak designated as M+1 is predominantly due to the natural abundance of which isotope?
(A) Deuterium (^{2}H)
(B) Carbon-13 (^{13}C)
(C) Nitrogen-15 (^{15}N)
(D) Oxygen-18 (^{18}O)

61. Which of the following is a key advantage of Raman spectroscopy in forensic drug analysis compared to IR spectroscopy?
(A) Direct non-destructive testing of drugs through transparent plastic packaging.
(B) Mandatory requirement that the drug analyte be completely dissolved in a highly specialized polar organic solvent.
(C) Complete reliance on dynamic dipole moment changes during vibration while totally ignoring non-polar symmetrical

ANSWERS

1. (B) It consists of oscillating electric and magnetic fields that are perpendicular to each other and to the direction of propagation.
Electromagnetic radiation represents a transverse wave phenomenon characterized by mutually perpendicular electric and magnetic field oscillations. These vector fields vibrate in phase with one another while propagating together through space or a material medium. Crucially, both oscillating fields remain strictly orthogonal to the direction along which the electromagnetic wave energy travels forward.

2. (D) Absorbance is the negative base-10 logarithm of transmittance.
The Beer-Lambert law mathematically defines absorbance as the negative base-ten logarithm of transmittance, expressed as A equals minus log ten of T. Here, transmittance represents the fraction of incident radiation transmitted through a sample solution. Consequently, absorbance increases linearly with concentration and path length while exhibiting an inverse logarithmic relationship with transmittance.

3. (A) 1, 4, 3, 2
Electromagnetic radiation energy is directly proportional to frequency and inversely proportional to wavelength. Within the electromagnetic spectrum, microwaves possess the lowest energy and longest wavelengths, followed by infrared radiation, then ultraviolet light, and finally X-rays, which feature high frequencies and short wavelengths. Therefore, the sequence listing these spectral regions in increasing energy order is microwave, infrared, ultraviolet, and X-ray.

4. (C) Association, dissociation, or reaction of the absorbing analyte molecules.
Chemical deviations from the Beer-Lambert law occur when the absorbing species undergoes chemical changes in solution as concentration alters. Interactions such as molecular association, dissociation, polymerization, or chemical reaction with the solvent alter the effective concentration or structure of the absorbing chromophore. These alterations disrupt the linear proportionality between measured absorbance and total analytical concentration.

5. (A) n to pi*
In ultraviolet-visible spectroscopy, electronic transitions involve promoting valence electrons to higher energy antibonding orbitals. Non-bonding electrons, represented as n electrons, are less tightly held than bonding sigma or pi electrons. Consequently, the transition from a non-bonding orbital to an antibonding pi star orbital requires a lower energy gap, causing it to occur at longer absorption wavelengths.

6. (B) I and III
Deviations from the Beer-Lambert law stem from real, instrumental, and chemical factors. At high analyte concentrations, electrostatic interactions between neighboring ions alter absorptivity, creating real deviations. High concentrations also modify the refractive index of the solution, causing non-linear absorbance behavior. Instrumental deviations arise from polychromatic light rather than perfectly monochromatic light, making statements I and III correct.

7. (B) An auxochrome
An auxochrome is a functional group containing non-bonding electron pairs, such as hydroxyl, amino, or halogen groups, that does not absorb UV-Vis radiation independently. However, when directly attached to a chromophore, its unshared electrons extend the conjugated system. This interaction shifts the absorption maximum to longer wavelengths and increases the molar extinction coefficient.

8. (C) Bathochromic shift
A bathochromic shift, commonly referred to as a red shift, denotes a change in the absorption spectrum where the wavelength of maximum absorption moves toward a longer wavelength lower energy region. This displacement typically results from structural modifications, such as increased conjugation or the addition of auxochromes, as well as changes in solvent environment.

Downloaded from www.pdf.tube

quadrupole analyzer, whereas ESI strictly requires a time-of-flight analyzer.

www.nodia.in

NODIA

moment throughout movement, no infrared absorption occurs, making both statements true with the reason explaining the assertion.

18. (C) 1650 - 1750 cm^{-1}
The carbonyl group containing a carbon-oxygen double bond exhibits a strong and highly characteristic absorption band in the infrared spectrum. This prominent stretching vibration occurs in the frequency range between 1650 and 1750 reciprocal centimeters. The high polarity and strong force constant of the double bond yield an intense spectral peak essential for organic identification.

19. (A) Simultaneous measurement of all light wavelengths for rapid spectrum acquisition.
Fellgett's advantage, also termed the multiplex advantage, refers to the capability of Fourier transform infrared spectrometers to collect data from all infrared wavelengths simultaneously using an interferometer. Unlike dispersive instruments that scan individual frequencies sequentially over time, multiplexing drastically reduces spectral acquisition times and significantly enhances overall signal-to-noise ratios during continuous spectroscopic measurement.

20. (B) I, II, and IV
Fourier Transform Infrared spectrometers replace dispersive optical elements like prisms or gratings with a Michelson interferometer. The interferometer splits light to generate a time-domain interferogram containing all wavelength information. Applying a mathematical Fourier transform converts this interferogram into a frequency-domain spectrum. This process yields superior throughput and higher signal-to-noise ratios, validating statements I, II, and IV.

21. (A) Potassium bromide
In transmission infrared spectroscopy, solid samples are routinely prepared by grinding the analyte fine powder with dry alkali halides, predominantly potassium bromide. Because potassium bromide is transparent to infrared radiation across the mid-IR range, compressing the uniform mixture under hydraulic pressure forms a clear pellet that permits unobstructed transmission analysis of sample absorption bands.

22. (D) The refractive indices of the ATR crystal and sample.
Attenuated Total Reflectance spectroscopy relies on an evanescent wave generated when infrared light undergoes internal reflection at the interface of a high refractive index crystal and sample. The depth of penetration of this wave into the sample depends mathematically on the light wavelength, incidence angle, and relative refractive indices of the internal reflection element and sample.

23. (B) Beam splitter
The Michelson interferometer in Fourier Transform Infrared instruments utilizes a central optical component known as a beam splitter. This semi-reflecting optic divides incoming polychromatic light into two separate paths, directing one portion to a stationary mirror and the other to a moving mirror. Recombining these reflected beams creates an interference pattern called an interferogram.

24. (C) FTIR-ATR microscopy
Analyzing microscopic trace evidence such as individual layers of multi-layered automotive paint requires non-destructive spatial resolution. Coupling a Fourier transform infrared spectrometer with an attenuated total reflectance microscope enables direct optical focus and chemical characterization of individual micro-layers. This configuration yields distinct infrared spectra without requiring laborious chemical extraction or destructive matrix destruction.

25. (B) Beam Splitter → Detector → Interferogram → Fourier Transform → Spectrum
In FTIR spectroscopy, source light first enters the interferometer where the beam splitter creates an interference optical path. After passing through the sample cell, the modulated light strikes the detector, generating a raw time-domain signal called an interferogram. Processing this interferogram through mathematical Fourier transformation yields the final readable frequency-domain infrared absorption spectrum.

26. (A) Inelastic light scattering
Raman spectroscopy relies on the inelastic scattering of monochromatic light, typically from a laser source, upon interaction with molecular vibrations. While most incident photons undergo elastic Rayleigh scattering without any energy loss, a tiny fraction exchanges vibrational energy with target molecular bonds, resulting

Click Here to Buy book on Flipkart

81. (B) The applied DC and RF voltage magnitudes at a constant ratio.
To scan across a mass spectrum in a quadrupole mass filter, the instrument progressively varies the magnitudes of both the direct current voltage and radio-frequency alternating voltage applied to the parallel rods while maintaining a constant DC to RF ratio. Sweeping these voltages dynamically shifts trajectory stability zones, allowing sequential transmission of increasing m/z ions.

82. (D) Magnetic sector analyzer
A magnetic sector mass analyzer utilizes a powerful curved electromagnet to deflect accelerated gas-phase ions traveling through an evacuated flight tube. As charged ions pass through the perpendicular magnetic field, Lorentz forces curve their trajectories. The radius of curvature depends on ion momentum, effectively separating ions based on mass-to-charge ratios before reaching a narrow collector exit slit.

83. (A) Background correction for broad band molecular absorption interference.
In Atomic Absorption Spectroscopy, the Zeeman effect utilizes a strong magnetic field to split atomic energy levels into polarized sub-components. Alternating magnetic field orientations or light polarization permits real-time differentiation between narrow atomic absorption lines and broad background interference caused by unevaporated matrix molecular absorption or light scattering, providing highly accurate background correction.

84. (C) Nebulizer
In atomic spectroscopy, sample solution introduction relies on a nebulizer. The nebulizer uses compressed carrier gas, typically pneumatic argon or air, to aspirate liquid samples and disperse them into a fine, uniform aerosol mist. This aerosol is directed into the spray chamber and thermal flame or ICP torch, enabling efficient desolvation, atomization, and excitation.

85. (A) K-alpha (Kα) X-ray
In X-ray emission notation, transitions are named according to the final shell vacancy and originating electron shell. When an inner K-shell electron is ejected, creating a photohole, an outer-shell electron drops to fill it. A electronic transition originating from the adjacent L shell down into the vacant K shell emits a characteristic K-alpha X-ray photon.

86. (D) Limit of Detection (LOD)
The Limit of Detection is defined in analytical spectroscopy as the lowest concentration of analyte in a sample matrix that can be reliably detected and distinguished from blank background noise with statistical confidence. While the LOD confirms analyte presence, quantitative precision and accuracy require higher analyte levels exceeding the formal Limit of Quantitation.

87. (B) Neutron Activation Analysis
Neutron Activation Analysis requires high thermal neutron fluxes typically produced inside nuclear reactors or specialized particle accelerators to induce nuclear reactions in sample matrices. Because small regional forensic laboratories lack physical access to active nuclear reactors and reactor safety infrastructure, routine implementation of NAA is highly impractical compared to benchtop laboratory techniques like ICP-MS or FTIR.

88. (C) Is inherently a non-destructive analytical technique.
A major forensic advantage of X-ray Fluorescence over Inductively Coupled Plasma Mass Spectrometry is its non-destructive nature. XRF analyzes metal tool physical surfaces directly without requiring chemical acid digestion or sample dissolution. Consequently, valuable evidentiary metallic tools remain completely intact and unaltered for court presentation or subsequent forensic testing, whereas ICP-MS requires destructive sample preparation.

89. (D) Gas Chromatography-Mass Spectrometry (GC-MS)
Gas Chromatography-Mass Spectrometry is widely acknowledged as the gold standard confirmation technique in forensic toxicology. Gas chromatography provides high-resolution physical separation of complex biological matrix components, while electron impact mass spectrometry generates reproducible diagnostic fragmentation patterns. Comparing analyte fragmentation spectra against established mass spectral libraries enables definitive structural identification of unknown drugs of abuse.

NODIA

capillary. Desolvation converts dissolved polar and non-volatile analytes into gas-phase ions. Consequently, ESI serves as an ideal interface for coupling High-Performance Liquid Chromatography with mass spectrometry, facilitating seamless online separation and sensitive structural analysis of biological fluids.

36. (B) 4, 2, 1, 3
A mass spectrometer processes samples through a strict sequential path of physical components. First, the sample inlet introduces the analytical specimen into the instrument. Second, the ion source converts neutral molecules into gas-phase ions. Third, the mass analyzer separates these generated ions by mass-to-charge ratio. Finally, the detector detects sorted ions, producing measurable output signals.

37. (A) Quadrupole
A quadrupole mass analyzer consists of four parallel cylindrical or hyperbolic metal rods positioned symmetrically. Applying combined direct current and radio-frequency electric voltages to opposing rod pairs creates an oscillating electrostatic field. Only ions with a specific mass-to-charge ratio maintain stable trajectories through the central field to reach the detector, while unstable ions collide with the rods.

38. (D) Proportional to the square root of its m/z ratio.
In a Time-of-Flight mass analyzer, ions are accelerated by a uniform electric potential into a field-free drift tube. Because all ions acquire identical kinetic energy, their velocities depend on mass. Mathematically, ion velocity is inversely proportional to the square root of m/z, making total drift flight time directly proportional to the square root of the mass-to-charge ratio.

39. (B) Trapping ions in a 3D field and selectively ejecting them by m/z.
An ion trap mass analyzer utilizes a central ring electrode and two endcap electrodes to establish a three-dimensional quadrupole radio-frequency electrostatic field. Generated ions are dynamically confined within this trapping space. Progressively scanning the radio-frequency voltage alters trajectory stability, selectively ejecting stored ions sequentially according to their mass-to-charge ratios toward an external electron multiplier detector.

NODIA

40. (C) Base peak
In a recorded mass spectrum, the ion peak displaying the maximum absolute intensity is designated as the base peak. For normalization and ease of spectral comparison, this most abundant ion signal is arbitrarily assigned a relative abundance value of one hundred percent. All other recorded fragment or molecular ion peaks are scaled relative to this primary intensity peak.

41. (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
In electron impact mass spectrometry, bombarding a neutral molecule with energetic electrons ejects a single electron from its molecular orbital. This process forms a radical cation known as the molecular ion, represented as M plus. Because electron mass is negligible, the mass-to-charge ratio of the unfragmented molecular ion directly reflects the exact molecular weight of the parent compound.

42. (A) An odd number of nitrogen atoms.
The Nitrogen Rule in mass spectrometry states that an organic molecule composed of carbon, hydrogen, oxygen, nitrogen, and halogens possessing an odd nominal molecular mass must contain an odd number of nitrogen atoms. Conversely, molecules with an even nominal molecular mass contain either no nitrogen atoms or an even number of nitrogen atoms.

43. (B) A carbonyl group with a gamma-hydrogen.
The McLafferty rearrangement is a characteristic intramolecular mass spectrometric fragmentation process occurring in carbonyl compounds containing a hydrogen atom at the gamma position. The rearrangement involves a six-membered cyclic transition state where the gamma-hydrogen transfers to the carbonyl oxygen, followed by cleavage of the beta-gamma carbon-carbon bond to yield an alkene and a stable radical cation.

44. (A) P-2, Q-3, R-4, S-1
Isotopic distributions produce unique mass spectral patterns. Chlorine contains 35Cl and ^{37}Cl, yielding an M+2 peak at 33% intensity. Bromine contains ^{79}Br and ^{81}Br, giving an M+2 peak near 100%. Carbon-13 generates an M+1 peak of 1.1% per carbon atom. Sulfur-34 yields

an M+2 peak near 4%, matching P-2, Q-3, R-4, and S-1.

45. (A) Two sequential mass analysis stages separated by ion fragmentation.
Tandem mass spectrometry, designated MS/MS, connects two mass analyzers in sequence separated by a collision cell. The first analyzer selects a specific precursor ion from complex mixtures. In the collision cell, energetic gas collisions induce fragmentation of this precursor ion. The second analyzer subsequently separates the resulting product fragment ions, delivering exceptional structural selectivity and high sensitivity.

46. (C) Free, neutral atoms in their ground state.
Atomic Absorption Spectroscopy measures the selective absorption of characteristic optical radiation by unexcited free neutral atoms in their ground electronic state. Sample solutions are atomized into a high-temperature flame or graphite furnace to desolvate and vaporize elemental species into ground-state atoms, which absorb resonance light emitted from an element-specific hollow cathode lamp.

47. (D) Hollow cathode lamp
Atomic Absorption Spectroscopy requires extremely narrow emission lines to match the narrow absorption profiles of free atoms. A hollow cathode lamp features a cathode constructed from or coated with the specific element being analyzed. Electrical ionization of inert filler gas causes sputtering of target metal atoms, emitting intense, narrow atomic resonance lines essential for element analysis.

48. (A) I, II, and III
In AAS, a hollow cathode lamp specific to the target element is required. ICP-AES measures light emitted by thermally excited atoms and ions returning to ground states, enabling simultaneous multi-element quantification. Graphite furnace AAS provides higher sensitivity and superior detection limits than flame AAS, making statement IV false while confirming statements I, II, and III.

49. (B) Argon
Inductively Coupled Plasma spectroscopy utilizes high-purity argon gas to form and sustain the plasma discharge. Argon gas is ionized by intense radio-frequency magnetic fields generated around a quartz torch assembly. Its high ionization energy enables complete desolvation, atomization, and excitation of aerosol sample droplets without forming interfering molecular bands, making argon ideal.

50. (C) 6,000 to 10,000 K
An argon inductively coupled plasma operates at extremely elevated operational temperatures ranging typically between 6,000 Kelvin and 10,000 Kelvin. This intense high-temperature plasma environment ensures nearly complete desolvation, atomization, and efficient ionization of introduced aerosol sample droplets, thereby effectively eliminating complex chemical matrix interferences that often complicate lower-temperature flame spectroscopic analytical methods.

51. (A) ICP-MS
Inductively Coupled Plasma Mass Spectrometry couples a high-temperature argon plasma ion source with a sensitive mass analyzer. The plasma efficiently converts sample elements into positive monatomic ions, which are extracted into a mass spectrometer for sorting by mass-to-charge ratios. This combined methodology delivers ultra-trace elemental sensitivity down to parts-per-trillion levels and enables precise isotopic profiling.

52. (C) Gamma rays
Neutron Activation Analysis is a sensitive nuclear technique where a sample is irradiated with thermal neutrons, causing stable target nuclei to capture neutrons and form radioactive isotopes. As these excited radioisotopes undergo radioactive decay, they emit characteristic prompt and delayed gamma-ray photons whose distinct energies and decay rates allow quantitative identification of elemental constituents.

53. (A) I and II
Neutron Activation Analysis measures total elemental concentrations nondestructively, leaving physical sample matrices largely intact. However, because neutron irradiation induces nuclear reactions within atomic nuclei without altering chemical bonding states, NAA cannot determine chemical oxidation states or chemical speciation. Moreover, it strictly requires access to nuclear reactors or intense neutron sources, making statements I and II correct.

Downloaded from www.pdf.tube

54. (D) Absorption of primary X-rays followed by emission of secondary X-rays.
X-ray Fluorescence spectroscopy operates by exposing a sample to high-energy primary X-ray radiation. Absorption of primary X-ray photons ejects tightly bound inner-shell electrons, creating atomic vacancies. When outer-shell electrons fall into these inner vacancies, secondary fluorescent X-rays with energies equal to the atomic orbital energy difference are emitted, providing diagnostic elemental signatures.

55. (B) Incident primary X-ray → Ejection of inner-shell electron → Outer-shell electron transition → Emission of secondary X-ray.
X-ray fluorescence follows a precise sequential physical mechanism. First, an incident primary X-ray strikes the target atom. Second, this high-energy radiation causes the ejection of an inner-shell electron, creating a photohole. Third, an outer-shell electron transitions down to fill the vacancy. Finally, the excess relaxation energy is emitted as a secondary characteristic X-ray photon.

56. (C) Bragg's Law
X-ray Diffraction relies on the constructive interference of monochromatic X-rays scattered by periodic atomic planes within a crystalline lattice. This physical phenomenon is governed mathematically by Bragg's Law, expressed as n lambda equals two d sine theta. Here, d represents interplanar crystal spacing, theta denotes the diffraction angle, and lambda represents the X-ray wavelength.

57. (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
X-ray diffraction is an exceptional technique for identifying specific crystalline phases in complex unknown solid mixtures. Because XRD measures interplanar lattice spacing according to Bragg's law, it yields unique diffraction patterns capable of distinguishing between chemical polymorphs and distinct solid compounds, making both the assertion and reason true with the reason providing the explanation.

58. (A) P-3, Q-1, R-2, S-4
Forensic evidence types align with optimal spectroscopic analytical techniques. X-ray diffraction determines specific crystal phases of solid explosives. Micro-XRF provides non-destructive elemental profiling of tiny glass fragments. ICP-MS enables ultra-trace heavy metal detection in hair samples. FTIR microscopy identifies organic binder formulations in paint chips, confirming the correct matching combination of P-3, Q-1, R-2, and S-4.

59. (B) Higher sensitivity and ability to measure isotopic ratios.
Inductively Coupled Plasma Mass Spectrometry offers significant advantages over Inductively Coupled Plasma Atomic Emission Spectroscopy. By detecting atomic mass-to-charge ratios directly rather than optical light emissions, ICP-MS achieves superior analytical sensitivity, lower detection limits down to parts-per-trillion, and the unique capability to quantify specific isotopic ratios for source discrimination in forensic investigations.

NODIA

60. (B) Carbon-13 (^{13}C)
In mass spectrometry, organic molecules predominantly display an M+1 isotopic peak directly adjacent to the main molecular ion peak. This satellite peak arises primarily from the natural abundance of carbon-13, which occurs at approximately 1.1 percent relative to carbon-12. Consequently, the relative height of the M+1 peak allows estimation of total carbon atom numbers.

61. (A) Direct non-destructive testing of drugs through transparent plastic packaging.
Raman spectroscopy provides a major forensic advantage for drug evidence analysis because visible or near-infrared laser light passes unimpeded through transparent plastic bags or glass containers. Amorphous polymers like polyethylene generate negligible Raman scattering interference, enabling direct, rapid, non-destructive identification of encapsulated suspected controlled substances without opening sealed evidentiary evidence bags or risking sample contamination.

62. (C) Electron multiplier
In routine benchtop gas chromatography-mass spectrometry systems, electron multipliers are predominantly utilized as ion detectors. When separated mass ions exit the mass analyzer, they strike a conversion dynode or continuous dynode surface, inducing secondary electron emissions. Successive dynode cascade multiplication exponentially amplifies weak ion currents into

robust electrical signals suitable for digital detection.

63. (D) Hypsochromic shift
A shift in absorption maximum toward shorter wavelengths, higher frequencies, and higher energies due to solvent polarity or structural changes is defined as a hypsochromic shift, also termed a blue shift. Solvation effects stabilize non-bonding ground electronic states more than excited states, increasing the transition energy gap and shifting the absorption band blue-ward.

64. (B) III only
MALDI and ESI are established soft ionization methods suitable for large, non-volatile biomolecules. Chemical Ionization operates under higher reagent gas pressures than high-vacuum Electron Impact. However, EI provides high internal energy that causes extensive cleavage in highly branched alkanes, usually failing to produce observable molecular ion peaks, making statement III incorrect while statements I, II, and IV are correct.

65. (B) Isolate a narrow wavelength band from polychromatic light.
In a dispersive ultraviolet-visible spectrophotometer, the primary function of a monochromator is to isolate a highly narrow wavelength band from incoming polychromatic light. Comprising entry slits, collimating optics, a dispersing element such as a diffraction grating or prism, and exit slits, the monochromator continuously selects monochromatic wavelengths to pass through sample solutions.

66. (D) Silicon carbide
A Globar source is a widely utilized thermal radiation source in infrared spectrometers. It consists of a solid silicon carbide rod electrically heated to temperatures around 1200 to 1500 degrees Celsius. Hot silicon carbide emits stable, continuous blackbody infrared radiation across the mid-to-far infrared spectral region, providing reliable illumination for sample absorption measurements.

67. (A) I and II
Infrared spectroscopy requires net dipole moment changes, whereas Raman scattering depends on polarizability changes during molecular vibration. Sample preparation is significantly simpler in Raman. Because water absorbs strongly in IR but yields weak Raman signals, statement III is false, confirming that statements I and II are both completely correct choices.

68. (C) Chemical interference
Chemical interference in Atomic Absorption Spectroscopy occurs when analyte species combine thermally with matrix anions to form thermostable, non-volatile refractory compounds within the flame cell. For instance, phosphate ions react with calcium to form calcium phosphate, suppressing atomization efficiency. Releasing agents or protective chelating agents are added to eliminate these chemical matrix effects.

69. (A) Remove carrier gas and lower pressure before entering the mass spectrometer.
Gas chromatography operates under atmospheric or elevated pressures using continuous carrier gas flow, whereas mass spectrometry requires high vacuum conditions inside the ion source and mass analyzer. A specialized interface, such as a jet separator or capillary direct transfer line, removes excess carrier gas and reduces operating pressure, permitting efficient ion transfer into high vacuum.

70. (D) Lead, Barium, and Antimony
Forensic analysis of gunshot residue focuses on identifying characteristic inorganic elemental constituents derived from primer mixtures. Primer formulations traditionally contain lead styphnate as an initiator, barium nitrate as an oxidizer, and antimony sulfide as a fuel. Detecting the simultaneous presence of lead, barium, and antimony provides definitive analytical confirmation of primer-derived gunshot residue particles.

71. (B) Bombarding a metal target (e.g., Copper) with high-energy electrons.
X-rays in analytical diffraction instruments are generated inside an evacuated X-ray tube. A tungsten filament is heated to emit high-energy electrons, which are accelerated across a high voltage potential to bombard a solid metal anode target, commonly copper. Inelastic collisions decelerate electrons and eject inner K-shell target electrons, emitting characteristic monochromatic X-ray radiation.

Click Here to Buy book on Amazon

72. (C) Scattering of light by dust or optical imperfections.
Stray light refers to any unwanted optical radiation reaching the detector at wavelengths outside the selected nominal spectral bandwidth. Instrumental factors such as Rayleigh scattering from dust particles, reflections off internal casing walls, or scratches on optical components introduce stray radiation. Stray light limits maximum measurable absorbance, causing negative deviations from Beer-Lambert linearity at high concentrations.

73. (C) 340 nm
Enzymatic determination of ethanol in biological samples utilizes alcohol dehydrogenase to oxidize ethanol while reducing NAD^+ to NADH. While oxidized NAD^+ absorbs light in the far ultraviolet, reduced NADH displays a distinct, strong UV absorption band centered at 340 nanometers. Monitoring the increase in absorbance at 340 nanometers allows precise quantitation of ethanol concentration in blood.

74. (A) A wavelength where two equilibrium species share identical molar absorptivity.
An isosbestic point is a specific wavelength in ultraviolet-visible absorption spectroscopy at which two chemical species existing in dynamic chemical equilibrium possess identical molar extinction coefficients. Consequently, total absorbance at this unique wavelength remains constant regardless of the relative concentrations or interconversion of the two absorbing species during chemical reactions or titration experiments.

75. (B) Bending vibrations
In infrared spectroscopy, molecular vibrations are broadly categorized as stretching or bending modes. Bending vibrations involve changes in bond angles between two bonds without altering interatomic bond lengths. Scissoring and rocking represent in-plane bending modes where bond angles alter within the molecular plane, whereas wagging and twisting represent out-of-plane bending modes where atoms move perpendicular to the plane.

76. (C) Hydroxyl O-H stretch
In an infrared spectrum, a broad, strong absorption band appearing between 3200 and 3600 reciprocal centimeters is characteristic of the O-H stretching vibration of hydroxyl functional groups, found in alcohols, phenols, and carboxylic acids. Intermolecular hydrogen bonding weakens O-H force constants, causing significant peak broadening and shifting absorption frequencies toward lower wavenumbers.

77. (A) Resolving power
Resolving power in mass spectrometry measures the ability of a mass analyzer to separate and distinguish two adjacent mass-to-charge ion peaks with small mass differences. Defined mathematically as nominal mass divided by mass difference, higher resolving power allows accurate resolution of isobaric ions sharing identical nominal masses, enabling precise elemental formula determination in complex biological or environmental samples.

NODIA

78. (C) It imparts minimal residual energy, yielding intact molecular ions with little fragmentation.
Soft ionization techniques in mass spectrometry transfer controlled, low residual energy to analyte molecules during ionization. Methods such as Chemical Ionization, Electrospray Ionization, and MALDI promote ion formation without imparting excess internal energy. Consequently, extensive bond cleavage is prevented, producing intense intact protonated or adduct molecular ions essential for accurate molecular weight determination.

79. (D) Aromatic compounds
In electron impact mass spectrometry, aromatic compounds display exceptionally stable molecular ion peaks. Delocalized pi electron systems within conjugated aromatic rings effectively distribute radical cationic charge generated upon electron ejection. This resonance stabilization reduces internal energy drive toward fragmentation, allowing intact molecular ions to reach the detector in high abundance relative to aliphatic hydrocarbons or alcohols.

80. (C) Chlorine
Chlorine possesses two naturally occurring stable isotopes, chlorine-35 and chlorine-37, with natural relative abundances of approximately seventy-five percent and twenty-five percent respectively. When a compound contains a single chlorine atom, its mass spectrum displays a characteristic M+2 isotopic peak with an intensity approximately one-third, or a 3:1 ratio, relative to the molecular ion peak.

CHAPTER 24

Handwriting Examination and Signature Analysis

1. What is the fundamental definition of a questioned document in forensic science?
(A) Any document containing handwritten notes used in a criminal investigation
(B) Any official government record that has been misplaced or lost
(C) Any document whose authenticity, origin, or authorship is disputed or under scrutiny
(D) Only documents that bear a forged signature

2. The primary neuromuscular centre that dictates the patterns and individuality of handwriting is located in the:
(A) Spinal cord
(B) Motor cortex of the brain
(C) Peripheral nervous system of the hand
(D) Medulla oblongata

3. Which of the following is considered a class characteristic in handwriting?
(A) A unique terminal stroke on the letter 'y'
(B) An unusual pen lift in the middle of a continuous word
(C) A characteristic tremor caused by a specific physical illness
(D) The copybook system of writing taught in a specific region

4. In document examination, the term "line quality" refers to:
(A) The smoothness and continuity of writing strokes
(B) The physical thickness and density of paper used
(C) The chemical composition of ink in the writing
(D) The precise structural dimensions of the pen nib

5. The fundamental principle of handwriting identification relies on which of the following axioms?
(A) Handwriting changes completely every five years
(B) Relatives share identical handwriting patterns due to genetics
(C) No two individuals write exactly alike in all details
(D) The writing instrument dictates the individual characteristics

6. What is the role of a document examiner when receiving a new case involving a questioned signature?
(A) To evaluate the questioned signature against reliable standard samples
(B) To declare the signature forged immediately upon initial visual inspection
(C) To directly interrogate the suspect to establish underlying context of writing
(D) To issue a final binding legal judgement regarding the document validity

7. Pen pressure in natural handwriting is typically:
(A) Completely uniform throughout the entire writing process
(B) Heaviest on upward strokes and lightest on downward strokes
(C) Non-existent when using a ballpoint pen
(D) Dynamic, varying seamlessly to create rhythm and shading

8. Given below are two statements, one labelled as Assertion (A) and the other as Reason (R):
Assertion (A): Traced forgeries generally exhibit poor line quality with prominent tremors and hesitations.
Reason (R): The forger focuses primarily on copying the exact form of the letters rather than maintaining the natural speed and rhythm of writing.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

Downloaded from www.pdf.tube

90. (A) MALDI ionizes from a solid matrix phase, while ESI ionizes from a liquid phase.
Matrix-Assisted Laser Desorption/Ionization and Electrospray Ionization are complementary soft ionization techniques that differ fundamentally in sample physical states. MALDI involves co-crystallizing analyte molecules with an organic matrix into a solid state before pulsed laser desorption. Conversely, ESI desolvates ions continuously from a liquid solution stream, making ESI ideal for liquid chromatography coupling.

www.nodia.in

NODIA

in scattered photons of altered frequencies that reveal structural information.

27. (B) Stokes lines
In Raman scattering, Stokes lines occur when incident monochromatic laser photons transfer energy to unexcited ground-state molecules, promoting them to higher vibrational states. Consequently, the scattered photons emerge with lower energy, lower frequencies, and longer wavelengths relative to the incident excitation light. Spectral features appearing at higher frequencies are conversely termed anti-Stokes lines.

28. (A) P-4, Q-3, R-1, S-2
Each analytical technique relies on distinct physical principles. UV-Visible spectroscopy measures electronic excitation transitions. Infrared spectroscopy detects changes in molecular dipole moments during vibration. Raman spectroscopy requires polarizability changes during molecular scattering. Mass spectrometry separates gas-phase ions according to mass-to-charge ratios. Combining these pairs yields the correct matching order of P-4, Q-3, R-1, and S-2.

29. (A) Vibrational modes that are IR active are Raman inactive, and vice versa.
The rule of mutual exclusion applies strictly to centrosymmetric molecules possessing an inversion center of symmetry. For such symmetrical structures, vibrational modes that are centrosymmetric preserve symmetry and produce polarizability changes, rendering them Raman active but IR inactive. Conversely, anti-symmetric modes change dipole moments, making them IR active but Raman inactive, preventing overlap between active frequencies.

30. (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
Raman spectroscopy is exceptionally suitable for non-destructive forensic analysis of analytes contained in transparent glass containers or dissolved in water. Water molecules and silica glass possess weak polarizability changes during vibration, yielding extremely weak background Raman signals. Consequently, matrix interferences remain minimal, enabling direct spectroscopic identification of target drug analytes through intact packaging without prior sample extraction.

31. (D) Mass-to-charge ratio
Mass spectrometry fundamental operation involves converting neutral analyte molecules into gas-phase charged ions within an ion source. These generated ions are subsequently accelerated into a mass analyzer, where dynamic electric or magnetic fields sort and resolve them exclusively based on their mass-to-charge ratio, denoted as m/z, rather than physical molecular size or elemental electronegativity.

32. (C) Electron Impact (EI)
Electron Impact ionization is classified as a hard ionization technique because high-energy electrons, typically around seventy electronvolts, collide with gaseous analyte molecules. This energetic impact imparts substantial residual excess internal energy to the formed molecular ion, causing extensive chemical bond cleavage and producing highly reproducible diagnostic fragment pattern spectra suitable for library matching.

33. (B) Methane
Chemical Ionization is a soft ionization technique where gas-phase analyte molecules interact with primary ions produced by electron bombardment of an excess reagent gas. Methane is widely used as a reagent gas, forming reactive species like CH_5^+ and $C_2H_5^+$. These reagent ions transfer protons to sample molecules, producing stable protonated molecular adduct ions with minimal structural fragmentation.

34. (B) I and III
Matrix-Assisted Laser Desorption/Ionization requires mixing target analytes with an excess of ultraviolet-absorbing organic matrix material. Upon laser irradiation, the matrix absorbs energy, desorbing and soft-ionizing intact macromolecules without destructive fragmentation. Because MALDI generates predominantly singly charged high-mass ions, it is routinely coupled with Time-of-Flight mass analyzers, confirming statements I and III as correct.

35. (A) Coupling with High-Performance Liquid Chromatography (HPLC).
Electrospray Ionization operates at atmospheric pressure, directly nebulizing liquid eluent into charged droplets through a high-voltage

Click Here to Buy book on Flipkart

9. Which of the following describes "pen scope"?
(A) The specific chemical formulation and viscosity of ink in the pen
(B) The angle at which the writing instrument is held relative to paper
(C) The reach of the hand and fingers without moving the wrist or arm
(D) The total longitudinal dimension and physical length of the pen barrel

10. Initial and terminal strokes in handwriting are highly significant for identification because:
(A) They remain identical across all writers who learned the exact same copybook system
(B) They dictate the overall structural alignment, letter proportions, and document slant
(C) They consistently exhibit the highest degree of pen pressure throughout writing
(D) They are executed subconsciously, making them difficult for a forger to copy

11. "Natural variation" in handwriting means that:
(A) A person never writes a letter the exact same way twice
(B) A person's handwriting changes intentionally to avoid detection
(C) The handwriting of different people naturally varies
(D) A person can perfectly imitate another's writing with practice

12. A signature executed by a person holding the pen while another person physically guides their hand is known as a:
(A) Traced signature
(B) Guided or assisted signature
(C) Simulated signature
(D) Spurious signature

13. Which of the following conditions is most likely to produce a "tremor of age" in handwriting?
(A) Intentional disguise
(B) Parkinson's disease or senility
(C) Writing in a moving vehicle
(D) Using a defective ballpoint pen

14. Consider the following statements regarding the collection of handwriting standards:
I. Requested standards are obtained by dictating text to the subject.
II. Collected standards are pre-existing documents executed during the normal course of business.
III. Requested standards are less likely to contain disguised writing than collected standards.
Which of the given statements is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

15. When examining the alignment of handwriting, the imaginary or actual line upon which the letters rest is called the:
(A) Ascender line
(B) Descender line
(C) Baseline
(D) Median line

16. A "spurious signature" is best defined as:
(A) A false signature produced by directly tracing over an authentic genuine model
(B) A detailed freehand drawing constructed by carefully copying a genuine model
(C) A legally authentic signature obtained from a person under physical coercion
(D) A signature created without attempting to imitate genuine writing characteristics

17. The primary advantage of a Video Spectral Comparator (VSC) in document examination is its ability to:
(A) Measure digital variations in handwriting slant and angle relative to baselines
(B) Extract biological samples and trace DNA profiles directly from paper surfaces
(C) Differentiate inks using specific infrared and ultraviolet light radiation
(D) Determine the exact physical mass and weight distribution of document paper

18. An individual writes an anonymous threatening letter and attempts to hide their identity by altering their handwriting. This is known as:
(A) Simulated writing
(B) Disguised writing
(C) Traced writing
(D) Natural variation

19. Match List I with List II:
List I: (Term)
P. Rhythm
Q. Slant
R. Proportion
S. Speed
List II: (Definition)
1. The angle of inclination of writing axes relative to the baseline

Downloaded from www.pdf.tube

2. The harmonious recurrence of stress, motion, and spacing
3. The relative size of various letters or parts of letters
4. The rapidity with which the writing is executed

(A) P-2, Q-1, R-3, S-4
(B) P-1, Q-2, R-4, S-3
(C) P-3, Q-4, R-1, S-2
(D) P-2, Q-3, R-1, S-4

20. Which of the following features is a strong indicator of simulated (freehand) forgery?
(A) Unnatural pen lifts and blunt endings
(B) Fluid, continuous strokes with rhythmic shading
(C) Tapering terminal strokes
(D) Wide pen scope with consistent baseline alignment

21. Which instrument is most appropriate for observing the sequence of intersecting strokes and fine paper fibre disturbances?
(A) Video Spectral Comparator
(B) Spectrophotometer
(C) Stereomicroscope
(D) Gas Chromatograph

22. In the context of thumb impressions on documents, a "latent" impression is one that is:
(A) Invisible or faint, needing chemical or physical development
(B) Formed directly using standard dark fingerprint ink on paper
(C) Pressed firmly into a soft substance like wax or sealing clay
(D) Deposited directly by blood or liquid transfer on a surface

23. A "master pattern" in the context of handwriting development refers to:
(A) The exact authentic signature model copied by a forger during simulation
(B) The digital reference template loaded into a Video Spectral Comparator
(C) The specialized physical grid overlay used to measure precise writing slant
(D) The mental image of a letter form that a writer subconsciously executes

24. What is the effect of severe alcohol intoxication on a person's handwriting?
(A) It causes a marked decrease in letter size, leading to micrographia
(B) It produces larger, careless, and significantly less legible writing
(C) It enhances writing speed while maintaining clear stroke neatness
(D) It alters the fundamental individual characteristics of writing entirely

NODIA

25. An unaccustomed writing surface, such as writing on a document held against a rough wall, will most likely affect:
(A) The spelling of the words
(B) The individual's fundamental spelling habits
(C) The line quality and baseline alignment
(D) The grammar of the sentence

26. Consider the following statements regarding handwriting disguise:
I. Changing the writing slant is one of the most common methods of disguise.
II. Disguise is easy to maintain consistently over a long document.
III. Writing with the unaccustomed (non-dominant) hand is a form of disguise.
IV. Disguised writing usually shows a higher writing speed than natural writing.

Which of the given statements are correct?
(A) I and II only
(B) I and III only
(C) II, III and IV only
(D) I, III and IV only

27. When requesting a suspect to provide handwriting standards, the investigator should:
(A) Dictate the text at varying speeds without showing the questioned document
(B) Allow the suspect to copy directly from the questioned document
(C) Show the suspect the questioned signature to ensure they know what to write
(D) Provide a completely different text that shares no words with the questioned document

28. "Adequacy" of handwriting standards refers to:
(A) Having standards written with the same type of pen and ink
(B) Having a sufficient quantity of writing to show natural variations
(C) Having standards written at the exact same time as the questioned document
(D) Ensuring the standards are notarized by a gazetted officer

29. Which of the following is NOT a method typically used to create a traced forgery?
(A) Carbon paper tracing
(B) Visual freehand memory drawing
(C) Indented tracing (using a stylus)
(D) Transmitted light tracing (using a window or light box)

30. Which of the following represents the correct sequence of examination when analyzing a questioned signature?
(A) Compare → Analyze Questioned → Analyze Standard → Evaluate
(B) Analyze Questioned → Analyze Standard → Compare → Evaluate
(C) Evaluate → Compare → Analyze Standard → Analyze Questioned
(D) Analyze Standard → Evaluate → Analyze Questioned → Compare

31. The term "rubric" in signature analysis refers to:
(A) The official legal seal or rubber stamp placed directly over a signature
(B) The specialized chemical solvent mixture used for paper ink extraction
(C) An individualized flourish or underlining accompanying a signature
(D) The physical grid measurement system used to determine letter proportions

32. In legal procedure, under Section 73 of the Indian Evidence Act (and corresponding provisions in Bharatiya Sakshya Adhiniyam), who has the power to direct any person present in court to write any words or figures for comparison?
(A) The Investigating Police Officer
(B) The Forensic Expert
(C) The Public Prosecutor
(D) The Court / Magistrate

33. An examiner observes microscopic dots of ink adjacent to the main strokes in a signature executed with a fountain pen. These are likely:
(A) Evidence produced during a carbon paper tracing process
(B) Hesitation marks created by a slow, deliberate forger
(C) Ink spatter resulting from rapid, dynamic pen strokes
(D) Indentations transferred from a previous notebook page

34. Consider the following statements regarding natural variation:
I. Natural variation proves that a signature is forged.
II. Complex and highly stylized signatures generally show more variation than simple ones.
III. True natural variation is confined within normal limits for that specific writer.
Which of the given statements is/are correct?
(A) I and II only
(B) II and III only
(C) III only
(D) I, II and III

35. "Patching" or "retouching" in handwriting refers to:
(A) Adding an explicit date line directly beneath a completed signature
(B) The natural, routine crossing of 't' stems or dotting of 'i' loops
(C) The physical overlapping of two distinct signatures on a document
(D) Corrective ink additions made to perfect a letter's appearance

36. Which characteristic of handwriting is most heavily influenced by the copybook system learned during childhood?
(A) Basic letter design and initial form
(B) Line quality
(C) Subconscious pen pressure variations
(D) Terminal stroke speed

37. The presence of a double line track, one indented without ink and one over it with ink, strongly indicates which type of forgery?
(A) Simulated forgery
(B) Spurious forgery
(C) Indented tracing forgery
(D) Optically transferred forgery

38. Given below are two statements, one labelled as Assertion (A) and the other as Reason (R):
Assertion (A): It is generally easier to determine that a signature is a forgery than to identify the specific author of the forgery.
Reason (R): A forger successfully hides their own individual characteristics while attempting to simulate the characteristics of the victim.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

Click Here to Buy book on Amazon

77. Consider the following statements regarding the examination of charred documents:
I. Charred documents are highly fragile and require extreme care in handling.
II. Infrared photography and oblique lighting are often used to decipher writing on charred documents.
III. Standard chemical ink solvents are applied directly to charred documents to restore them.
Which of the given statements is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

78. A "holographic document" in forensic terms is defined as:
(A) A document written and signed entirely in one author's hand
(B) A legal instrument incorporating an anti-counterfeiting 3D security hologram feature
(C) A digitally created text document stored in an encrypted electronic format
(D) A high-resolution photocopy reproduction of a disputed or forged legal will

79. Consider the following statements about the comparison methodology:
I. Class characteristics alone are sufficient for identifying a specific writer.
II. A combination of multiple, unique individual characteristics is required for a positive identification.
III. Unexplained fundamental differences between the standard and questioned writing generally indicate different authors.
Which of the given statements is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

80. The primary limitation of requested standards is that:
(A) They are easily obtained without requiring formal authorization or court orders
(B) They are held legally inadmissible across various state jurisdiction courts
(C) They are consistently executed using low-quality or defective writing instruments
(D) Writers know samples are collected and may intentionally disguise writing

81. A magnifier used in document examination often features an engraved glass scale. This is primarily used to measure:
(A) The complex chemical composition and elemental structure of ink
(B) The estimated chronological age and degradation of the document
(C) Exact dimensions, spacing, and letter sizes of writing
(D) The total moisture content and structural porosity of paper

82. If a questioned signature shows a drawn appearance, lacks fluidity, has blunt beginnings and endings, and perfectly matches a known signature in every proportional detail when superimposed, it is most likely a:
(A) Natural genuine signature
(B) Traced forgery
(C) Disguised genuine signature
(D) Spurious forgery

83. Match List I with List II:
List I: (Instrument)
P. Magnifying Glass
Q. Stereomicroscope
R. ESDA (Electrostatic Detection Apparatus)
S. VSC (Video Spectral Comparator)
List II: (Application in Document Exam)
1. Decoding indented writing on a notepad
2. Differentiating inks based on IR/UV properties
3. Basic field observation of line quality
4. 3D observation of intersecting strokes and paper fibre disturbance
(A) P-3, Q-4, R-1, S-2
(B) P-4, Q-3, R-2, S-1
(C) P-1, Q-2, R-3, S-4
(D) P-3, Q-1, R-4, S-2

84. In analyzing a forged signature, what does "blunt terminal stroke" typically indicate?
(A) Stopping the pen abruptly rather than lifting it in motion
(B) Unusually rapid writing speed during signature execution
(C) Writing performed with a newly manufactured ballpoint pen
(D) Normal age-related physiological variation in an elderly writer

85. Arrange the following handwriting characteristics from the most general to the most specific for identification purposes:

NODIA

49. Consider the following statements regarding the examination of thumb impressions on documents:
I. A magnifier and a ridge counter are common tools for this examination.
II. The presence of a core and delta is irrelevant for thumb impression comparison.
III. Smudged or over-inked thumb impressions can obscure individual ridge characteristics.
Which of the given statements is/are correct?
(A) I and II only
(B) I and III only
(C) II and III only
(D) I, II and III

50. The visual difference between the "tremor of fraud" and the "tremor of age" is that:
(A) Tremor of fraud occurs exclusively on terminal strokes, whereas tremor of age affects initial strokes only
(B) Tremor of fraud shows misplaced hesitation, while tremor of age is generally consistent throughout strokes
(C) Tremor of age manifests exclusively in capital letters, whereas tremor of fraud appears in lowercase text
(D) There is absolutely no observable microscopic difference between the two types of handwriting tremors

51. The "x-height" in handwriting analysis refers to:
(A) The total vertical dimension and overall height of the physical paper sheet
(B) The vertical distance measured between the baseline and descender margin line
(C) The maximum horizontal stroke width of the lowercase letter 'x' in writing
(D) The height of lowercase letters lacking ascenders or descenders

52. When two strokes cross, determining the "sequence of intersecting strokes" helps the examiner establish:
(A) Chronological stroke order to detect document alterations
(B) The approximate age and chronological maturity of the author
(C) The exact geographical factory origin of the paper substrate
(D) The commercial brand and chemical formulation of ink utilized

53. Under which section of the Indian Evidence Act, 1872 (or corresponding provisions in Bharatiya Sakshya Adhiniyam, 2023) does a document examiner provide expert testimony in court?
(A) Section 25
(B) Section 154
(C) Section 45
(D) Section 300

54. A "blind forgery" is another term used for a:
(A) Spurious forgery
(B) Traced forgery
(C) Simulated forgery
(D) Guided forgery

55. What type of lighting is specifically used in a Video Spectral Comparator (VSC) to view security features like watermarks or to detect mechanical erasures?
(A) Coaxial reflected illumination directed across the paper surface
(B) High-intensity infrared luminescence radiation source
(C) Shortwave ultraviolet spectral light projection
(D) Transmitted light shining from beneath the paper

56. Match List I with List II:
List I: (Type of Forgery)
P. Simulated Forgery
Q. Traced Forgery
R. Spurious Forgery
S. Guided Signature
List II: (Key Identifying Feature)
1. Presence of indented guidelines or carbon residue
2. No resemblance to the genuine signature's style
3. Unnatural stops, pauses, and drawing-like execution trying to copy a model
4. Drastic change in line quality and dual writing impulses
(A) P-3, Q-1, R-2, S-4
(B) P-1, Q-3, R-4, S-2
(C) P-4, Q-2, R-1, S-3
(D) P-3, Q-2, R-1, S-4

57. Which feature is highly individualistic in the examination of the lowercase letter 't'?
(A) The linguistic classification of the letter as a consonant symbol
(B) The basic vertical stem structure standardly taught in copybooks
(C) The placement, length, and slant of the t-bar crossing

Downloaded from www.pdf.tube

ANSWERS

1. (C) Any document whose authenticity, origin, or authorship is disputed or under scrutiny
In forensic science, a questioned document refers to any material containing handwritten, printed, or typed marks whose source, origin, or authenticity is uncertain or under legal dispute. The primary objective of forensic document examination is to analyze physical and chemical attributes, establish origin, detect alterations, and verify whether the document is genuine or fraudulent.

2. (B) Motor cortex of the brain
Handwriting is predominantly a complex motor skill originating in the motor cortex of the brain. The brain formulates the mental image of letters and sends nerve impulses through the nervous system to control the fine motor muscles of the hand. This neurological control produces consistent, individual writing habits that remain personal across different writing instruments.

3. (D) The copybook system of writing taught in a specific region
Class characteristics are features shared by a group of writers who learned the same system or style of writing, such as a regional copybook method. These characteristics reflect formal instruction rather than individual habits. While class characteristics help categorize writing and narrow down potential sources, individual characteristics are required to uniquely identify a specific writer.

4. (A) The smoothness and continuity of writing strokes
Line quality describes the overall appearance and mechanical flow of written strokes, encompassing smoothness, fluency, rhythm, and continuity. High line quality features smooth, continuous, and confident strokes executed without hesitation. In contrast, poor line quality exhibits tremors, unexpected pen lifts, and uneven pressure, which often indicate forgery, physical impairment, or deliberate writing disguise.

5. (C) No two individuals write exactly alike in all details
The core principle of handwriting analysis rests on the axiom that no two individuals possess identical handwriting when evaluating every feature and habit. Although people may learn identical copybook styles, natural variation, motor control, and physical habits create unique individualizing features. These complex combinations of individual characteristics allow document examiners to reliably determine authorship across questioned samples.

6. (A) To evaluate the questioned signature against reliable standard samples
When investigating a disputed signature, a forensic document examiner side-by-side evaluates the questioned item against reliable standard samples of known authorship. This objective forensic methodology involves detailed side-by-side comparison of individual habits, line quality, slant, and structural features. The examiner collects scientific evidence to determine authenticity or forgery rather than issuing immediate legal judgments or conducting interrogations.

NODIA

7. (D) Dynamic, varying seamlessly to create rhythm and shading
Natural handwriting features dynamic variations in pen pressure, which naturally shift as the pen moves across paper. Pressure tends to increase on downward strokes due to muscular movement and lighten on upward strokes. This fluid, rhythmic variation creates characteristic shading and line variations that are difficult for a forger to replicate, as forgeries typically display uniform pressure.

8. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Traced forgeries exhibit poor line quality, tremors, and hesitations because the process requires slow, conscious copying over a guide. The forger directs attention toward accurately reproducing letter outlines rather than preserving natural writing speed, rhythm, and pressure variations. Consequently, this focus on spatial form impairs execution speed and introduces

flow of the writing instrument used

67. If an individual usually writes with their right hand but provides requested standards using their left hand to avoid identification, this is a form of:
(A) Spurious forgery
(B) Natural variation
(C) Ambidextrous tracing
(D) Disguise

68. Given below are two statements, one labelled as Assertion (A) and the other as Reason (R):
Assertion (A): It is generally unacceptable to rely on only one or two signatures as a standard for comparison.
Reason (R): A small sample size cannot adequately establish the range of the writer's natural variation.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

69. Which component of handwriting is least likely to be successfully disguised by an individual for a prolonged period?
(A) Overall writing slant and angle relative to the baseline
(B) The relative height and overall size of capital letters
(C) Subconscious connecting strokes and letter proportions
(D) The general decorative style of a personal signature

70. "Stepped alignment" in handwriting means that:
(A) Words drop progressively, creating a descending staircase alignment
(B) Words consistently curve upwards in an ascending arc toward the right margin
(C) The writing baseline remains perfectly straight and parallel across the page
(D) Text lines are strictly confined and enclosed within ruled page margins

71. In document examination, what does the acronym "VSC" stand for?
(A) Visual Signature Comparator
(B) Variable Stroke Calculator
(C) Visual Spectral Camera
(D) Video Spectral Comparator

72. During an examination, identifying "eyelet" formations refers to analyzing:
(A) The punctuation dots positioned over lowercase letters like 'i' and 'j'
(B) Small closed loops in letters such as 'a', 'e', or 'o'
(C) Elaborate decorative flourishes placed at the conclusion of a signature
(D) Security watermarks embedded and visible within the paper structure

73. Which of the following best describes the "comparability" requirement for handwriting standards?
(A) Standards must be written on paper produced by the exact same manufacturer
(B) Standards must undergo independent comparative analysis by multiple experts
(C) Standards must feature matching letters, words, and text combinations
(D) Standards must be written in capital letters whenever questioned text is cursive

74. Which of the following correctly identifies the sequence of ridge counting in a thumb impression for forensic comparison?
(A) Count ridges from the delta to the core
(B) Count all ridges within the entire pattern area
(C) Count only the bifurcations across the pattern
(D) Count ridges from the core to the delta

75. In handwriting comparison, the term "individual characteristics" refers to:
(A) Personal copybook deviations unique to a specific writer
(B) Standard letter formations taught universally during primary school education
(C) Structural defects resulting from the manufacturing process of writing tools
(D) Frequent grammatical and spelling errors committed by a particular author

76. What is a "descender" in handwriting analysis?
(A) Letter portions extending above the x-height baseline zone (e.g., in b, d, h)
(B) Letter portions extending below the baseline (e.g., in g, j, p, y)
(C) Entire signatures that exhibit a pronounced downward slant trend
(D) The natural reduction in pen pressure occurring at word endings

Click Here to Buy book on Flipkart

39. A signature that appears highly artistic, perfectly matches a known genuine model, and lacks any natural variation when superimposed over the model is most likely a:
(A) Genuine signature executed under stress
(B) Disguised signature
(C) Guided signature
(D) Traced forgery

40. A handwriting expert issues a report stating that "the questioned writing was probably written by the author of the standard writing." This is an example of a/an:
(A) Positive identification
(B) Qualified opinion
(C) Inconclusive opinion
(D) Elimination

41. In the examination of questioned documents, what is meant by the term "contemporaneous standards"?
(A) Standards written in the identical language and script as the questioned text
(B) Standards written independently by a contemporary associate of the suspect
(C) Standards executed around the same time frame as the questioned item
(D) Standards officially notarized and verified by an authorized legal officer

42. A person attempting to forge a signature via freehand simulation will most likely fail to accurately reproduce the victim's:
(A) The correct alphabetical spelling of the victim's name
(B) The general overall physical size and height of letters
(C) The specific color or shade of the ink writing instrument
(D) The dynamic speed and rhythmic pen pressure variations

43. Arrange the following steps of processing a questioned document at a crime scene in the correct sequential order:
1. Photographing the document in its original position
2. Placing the document in a protective envelope
3. Labelling and sealing the envelope
4. Picking up the document using forceps or gloved hands

Which of the following is the correct order?
(A) 1, 4, 2, 3
(B) 4, 1, 2, 3
(C) 1, 2, 4, 3
(D) 4, 2, 1, 3

44. When dealing with illiterate or semi-literate individuals, signatures are often substituted with:
(A) Typewritten names
(B) Thumb impressions
(C) Barcodes
(D) Printed block letters

45. Which of the following is a limitation of examining photocopied documents instead of originals?
(A) Photocopiers automatically fix grammatical errors present in handwritten text
(B) Photocopiers obscure stroke line quality, pen pressure, and stroke sequence
(C) Photocopiers alter original letter spellings during the reproduction process
(D) Photocopiers prevent examiners from observing basic class characteristics

46. The examination of an indented writing (a secondary impression left on a pad below the written page) is best accomplished using:
(A) Oblique (side) lighting
(B) Transmitted light
(C) Ultraviolet light
(D) Chemical bleaching

47. "Connecting strokes" in cursive handwriting refer to:
(A) The specialized loop strokes forming upper ascenders in letters such as 'l'
(B) The distinct horizontal crossing strokes found across letters like 't' and 'x'
(C) The continuous lines joining adjacent letters within a single word
(D) The initial stroke executed when beginning an isolated capital letter

48. Writing executed by a person suffering from a severe physical illness that weakens their motor control will typically show:
(A) High writing speed accompanied by fluid stroke execution
(B) Rhythmic, smooth variations in pen pressure throughout text
(C) Precise and consistent adherence to a straight baseline
(D) Tremor, irregular alignment, and degraded line quality

NODIA

1. Individual peculiarities (e.g., unique flying t-bars)
2. Copybook system taught in a geographical region
3. Family or group stylistic influences
4. Subconscious natural variations within the writer's own style

Which of the following is the correct order?
(A) 2, 3, 1, 4
(B) 2, 3, 4, 1
(C) 3, 2, 1, 4
(D) 4, 1, 3, 2

86. Which of the following is considered an "intrinsic" physical factor affecting handwriting?
(A) A neuromuscular disease suffered by the writer
(B) The type of paper used
(C) The lighting in the room
(D) The writing instrument (e.g., fountain pen vs pencil)

87. Given below are two statements, one labelled as Assertion (A) and the other as Reason (R):
Assertion (A): The opinion of a handwriting expert is subject to cross-examination in court.
Reason (R): Handwriting identification is an exact science with zero margin of error, similar to chemical elemental analysis.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

88. A document examiner discovers that a signature has been constructed by piecing together letters cut from various documents and photocopied to appear as a single signature. This is an example of a/an:
(A) Guided or physically assisted signature execution
(B) Cut-and-paste (composite) forgery
(C) Freehand simulation signature technique
(D) Indented stylus tracing process

89. Consider the following statements regarding handwriting evaluation:
I. No conclusion can be drawn from a single, highly simplistic signature consisting of only a few strokes.
II. Over-reliance on class characteristics can lead to a false positive identification.
III. It is possible to perfectly determine the writer's age and gender solely from their handwriting.
IV. A stereomicroscope provides a three-dimensional view aiding in determining sequence of strokes.
Which of the given statements are correct?
(A) I, II and IV only
(B) II, III and IV only
(C) I and III only
(D) I, II, III and IV

90. Match List I with List II:
List I: (Opinion Terminology)
P. Positive Identification
Q. Probable
R. Inconclusive
S. Elimination
List II: (Meaning)
1. The standard and questioned writings were definitely not written by the same person
2. Evidence points strongly to one writer, but falls short of absolute certainty
3. The standard and questioned writings were definitely written by the same person
4. The evidence is insufficient to determine whether the writings share authorship
(A) P-3, Q-2, R-4, S-1
(B) P-3, Q-4, R-2, S-1
(C) P-1, Q-2, R-4, S-3
(D) P-2, Q-3, R-1, S-4

NODIA
www.nodia.in

(D) The physical presence of dark black or blue ink on paper

58. Disguised writing is characterized by an internal conflict because the writer is trying to:
(A) Execute writing at a significantly faster rate than their normal writing speed
(B) Mimic the complex handwriting characteristics of a known target victim perfectly
(C) Write entire sentences in a completely unfamiliar foreign language or script
(D) Suppress automatic writing habits while adopting new conscious ones

59. When comparing handwriting, a "collected standard" refers to:
(A) Samples taken from pre-existing personal or official records
(B) Samples executed by a suspect specifically at the direct request of law enforcement officers
(C) Standardized copybook letter designs used for teaching children in primary school systems
(D) The original disputed document itself after being collected from the crime scene location

60. Which of the following represents the correct sequence of handwriting development in a human being?
(A) Conscious attention to letter forms → Repetition and practice → Subconscious/ automatic writing habit
(B) Subconscious/automatic writing habit → Conscious attention to letter forms → Repetition and practice
(C) Repetition and practice → Conscious attention to letter forms → Subconscious/ automatic writing habit
(D) Subconscious/automatic writing habit → Repetition and practice → Conscious attention to letter forms

61. "Micrographia" is a condition often associated with which disease, significantly affecting handwriting size?
(A) Malaria
(B) Parkinson's disease
(C) Tuberculosis
(D) Dengue

62. Consider the following statements regarding the evaluation of signatures:
I. A person's signature often evolves and simplifies over their lifetime.
II. Signatures usually display a higher writing speed than the person's normal text writing.
III. A genuine signature never contains any natural variation.
IV. Illiterate individuals often use standardized artistic signatures.
Which of the given statements are correct?
(A) I and II only
(B) II and III only
(C) I, II and IV only
(D) I and IV only

63. "Pen lifts" that occur in unnatural places, such as in the middle of a continuous letter, are strong indicators of:
(A) Rapid, highly fluent genuine writing
(B) Severely impaired intoxicated writing
(C) Simulated or traced forgery
(D) High-quality fountain pen usage

64. When evaluating the spacing in handwriting, "inter-word spacing" refers to:
(A) The blank space left at the margins of the page
(B) The vertical distance between two lines of text
(C) The distance between two letters within the same word
(D) The horizontal distance between two consecutive words

65. "Hesitation" in handwriting examination is best defined as:
(A) Stopping the pen completely, lifting it off the paper, and beginning a fresh word
(B) The natural, rhythmic pause that occurs between writing consecutive sentences
(C) Slower, uncertain stroke execution causing ink pooling or tremor
(D) The intentional, deliberate misspelling of complex words within a document

66. A suspect is asked to write "The quick brown fox jumps over the lazy dog" multiple times. Why is this specific pangram useful in document examination?
(A) It evaluates the suspect's cognitive intelligence level and linguistic abilities
(B) It contains every letter of the alphabet for a comprehensive sample
(C) It is a mandatory statutory requirement under procedural forensic law guidelines
(D) It assesses the structural ink quality and

Downloaded from www.pdf.tube

unnatural hesitation marks throughout the resulting signature.

9. (C) The reach of the hand and fingers without moving the wrist or arm
Pen scope defines the physical range or distance that fingers and hand can write continuously across paper without shifting the wrist or forearm position. It is influenced by individual hand size, flexibility, and motor habits. Examiners evaluate scope alongside alignment and spacing, as fixed wrist positioning impacts letter sizing, baseline curvature, and natural slant patterns.

10. (D) They are executed subconsciously, making them difficult for a forger to copy
Initial and terminal strokes are crucial individualizing features in document examination because they are executed subconsciously at the beginning and end of writing movements. Writers rarely focus consciously on these strokes, producing flying starts and tapered ends. Forgers concentrate on letter shapes, leading to noticeable blunt starts, unnatural pauses, or heavy terminal pen lifts.

11. (A) A person never writes a letter the exact same way twice
Natural variation is an inherent feature of human handwriting, meaning no writer reproduces a signature or character identically across multiple attempts. Physical factors, writing speed, surface variations, and minor motor deviations create slight differences between executions. Despite these variations, the fundamental individual characteristics remain within a predictable master pattern unique to that specific writer.

12. (B) Guided or assisted signature
A guided or assisted signature occurs when a writer's hand is physically held or supported by another individual during the writing process, often due to weakness or illness. This cooperative execution produces dual writing impulses, exhibiting erratic line quality, sudden directional changes, variable pressure, and conflicting muscular movements attributable to both participants.

13. (B) Parkinson's disease or senility
A tremor of age or physiological illness is caused by neurodegenerative disorders such as Parkinson's disease, senility, or physical weakness. Unlike tremors caused by fraudulent simulation, pathological tremors show consistent, involuntary muscular instability, rhythmic oscillations, degraded stroke line quality, and persistent alignment shifts that affect writing continuously throughout all characters and words.

14. (A) I and II only
Handwriting standards are categorized into requested and collected samples. Requested standards are obtained by law enforcement through dictation, whereas collected standards consist of pre-existing documents executed during ordinary business affairs. Requested standards carry a higher risk of deliberate disguise because writers know their writing is being sampled, making statement III incorrect while statements I and II are valid.

15. (C) Baseline
The baseline in document examination refers to the real or imaginary line upon which the bodies of letters rest. Baseline alignment reflects a habitual motor trait, which may appear straight, slanted, curved, stepped, or erratic relative to page margins. Analyzing baseline alignment provides vital evidence when comparing disputed handwriting with known exemplar samples.

NODIA

16. (D) A signature created without attempting to imitate genuine writing characteristics
A spurious signature, also termed a simple or blind forgery, is created when the forger writes a signature without relying on or attempting to imitate genuine model signatures. The writer uses their own handwriting style or an invented form. Consequently, spurious signatures show no stylistic resemblance to the victim's authentic signature during forensic evaluation.

17. (C) Differentiate inks using specific infrared and ultraviolet light radiation
The Video Spectral Comparator is an advanced optical examination instrument that utilizes selective light illumination across ultraviolet, visible, and infrared spectrums. It measures spectral luminescence, absorption, and fluorescence properties to differentiate visually similar inks, uncover hidden or obliterated text, highlight mechanical erasures, and inspect security features on questioned documents non-destructively without damaging paper.

37. (C) Indented tracing forgery
Indented tracing forgery involves placing a genuine signature over a document and tracing it with a sharp stylus to create an uninked groove on the lower page. The forger subsequently fills this groove with ink. Misalignment between the indented groove and ink stroke reveals a distinct double track, providing definitive evidence of tracing.

38. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Establishing that a signature is forged is generally easier than identifying the specific forger. When creating a forgery, the perpetrator suppresses their individual writing habits while attempting to imitate the victim's style. This suppression removes personal identifying features from the forged signature, leaving insufficient individual characteristics to link the writing to the perpetrator.

39. (D) Traced forgery
Superimposition of identical signatures indicates traced forgery because natural variation prevents an individual from writing two signatures with exact mathematical congruence. When a questioned signature matches a genuine reference model in every dimension and lacks fluid execution or variation, it proves the signature was directly reproduced through a tracing process.

40. (B) Qualified opinion
A qualified opinion expresses varying degrees of probability rather than an absolute identification or complete elimination. Standard terminology such as "probably written by" indicates that significant handwriting similarities exist between questioned and standard samples, but limitations in specimen quality, quantity, or individual variation prevent the forensic examiner from formulating a definitive conclusion.

41. (C) Standards executed around the same time frame as the questioned item
Contemporaneous standards are reference writing samples executed close to the date of the questioned document. Writing habits naturally evolve over time due to aging, health changes, or practice. Utilizing contemporaneous standards minimizes temporal variations, ensuring comparative evaluations accurately reflect the writer's habits at the specific time the disputed document was created.

42. (D) The dynamic speed and rhythmic pen pressure variations
When executing a freehand simulation, a forger relies on slow, deliberate movements to accurately copy letter shapes. This conscious effort prevents reproducing dynamic writing speed, continuous rhythm, and subtle pen pressure variations inherent in authentic signatures. As a result, simulated signatures display unnatural hesitation, uniform stroke width, and poor line quality.

43. (A) 1, 4, 2, 3
Processing physical document evidence requires systematic chain-of-custody protocols. First, the document is photographed in its original context at the crime scene. Next, it is carefully collected using clean forceps or gloved hands to prevent contamination. The document is then placed into a protective envelope, which is properly labelled and sealed for transport.

44. (B) Thumb impressions
In formal legal and administrative execution transactions involving illiterate or semi-literate individuals, thumb impressions serve as reliable official substitutes for written signatures. Friction ridge patterns on human thumbs possess unique minutiae details, core structures, and delta configurations, enabling forensic fingerprint examiners to definitively confirm individual identity and authenticate legal instruments.

45. (B) Photocopiers obscure stroke line quality, pen pressure, and stroke sequence
Examining photocopied documents presents significant forensic limitations because optical reproduction flattens three-dimensional paper surface details. Photocopiers obscure subtle pen pressure variations, stroke sequence at intersection points, fine line quality, microscopic hesitations, and physical embossing. Original documents are necessary to thoroughly evaluate physical stroke characteristics and detect sophisticated forgery or tracing methods.

46. (A) Oblique (side) lighting
Indented writing consists of physical impressions left on underlying pages when writing on an upper sheet. Oblique or side lighting directs light across the document surface at a low angle, casting shadows within the indented grooves. These contrasting highlights and shadows illuminate hidden depressions, allowing

Click Here to Buy book on Amazon

STUDYING FROM PDFs?

THINK AGAIN.

If you are studying only from PDFs,
you are wasting valuable time.

Research shows that learning from

PRINTED BOOKS has up to

4× HIGHER RETENTION

than studying from screens.

PRINT BOOK = BETTER MEMORY

PDF = LOWER RETENTION

Those who study from **PRINTED BOOKS**
move **AHEAD.**

Others are left **BEHIND**
in competition.

In competitive exams,
being average is not enough.

STAY ONE STEP AHEAD.

withholding questioned documents. Showing the disputed document enables suspects to copy or deliberately disguise their writing. Dictation forces subjects to rely on automatic writing habits, while varying speed limits conscious disguise attempts and captures normal individual variations effectively.

28. (B) Having a sufficient quantity of writing to show natural variations
Adequacy in handwriting standards denotes having a sufficient volume of sample writing to fully reveal the writer's natural variation range and individual characteristics. A limited sample may fail to illustrate consistent habits or variable stroke patterns. Collecting multiple standard specimens ensures document examiners can evaluate consistency and conduct reliable side-by-side comparative evaluations.

29. (B) Visual freehand memory drawing
Traced forgeries are created by directly copying a genuine signature using physical guides, such as carbon paper transfer, transmitted light tracing, or indented stylus impressions. In contrast, visual freehand memory drawing involves attempting to recreate a signature from memory without a direct physical template overlay, which represents a simulation technique rather than tracing.

30. (B) Analyze Questioned → Analyze Standard → Compare → Evaluate
Forensic document examination follows a structured methodology starting with independent analysis of the questioned item to observe characteristics without bias. Next, standard reference samples are independently analyzed to establish individual habits and natural variation range. The examiner then compares characteristics across samples and finally evaluates differences and similarities to formulate an opinion.

31. (C) An individualized flourish or underlining accompanying a signature
A rubric refers to an ornamental underline, flourish, or decorative stroke added beneath or around a signature. Executed as a habitual, highly stylized movement, a rubric exhibits personal motor patterns, pressure distribution, and speed. Examiners analyze these decorative additions alongside letter structures because they contribute valuable individual characteristics during forensic signature comparisons.

32. (D) The Court / Magistrate
Section 73 of the Indian Evidence Act empowers the court or magistrate to direct any person present in court to write words or figures for comparison purposes. This statutory power enables judicial officers to obtain direct handwriting standards under court supervision, ensuring standard specimens are available to compare against questioned documents in legal proceedings.

33. (C) Ink spatter resulting from rapid, dynamic pen strokes
Microscopic ink droplets or spatters deposited alongside primary writing strokes occur during fast, energetic pen movements, especially with liquid ink instruments like fountain pens. As the nib moves rapidly across paper, sudden changes in direction release tiny ink droplets. This dynamic spattering signifies fluent, high-speed execution rather than slow, hesitant forgery.

34. (C) III only
Natural variation represents normal differences in genuine writing and does not indicate forgery, making statement I false. Highly complex signatures contain varied dynamic strokes but remain bound within a writer's master pattern, whereas statement III correctly asserts that genuine variation is strictly confined within predictable limits for a given author.

35. (D) Corrective ink additions made to perfect a letter's appearance
Patching or retouching refers to carefully applying ink additions over existing strokes to correct defects or improve letter appearances. While minor retouching can occur naturally in genuine writing, frequent or deliberate patching in questioned signatures often indicates forgery, where the writer attempts to repair imperfectly executed strokes to match a target model.

NODIA

36. (A) Basic letter design and initial form
The copybook system taught during formal childhood education primary dictates basic letter construction, shapes, and structural design. These class characteristics form the initial baseline for writing development. As individuals continue writing over time, personal motor habits, subconscious movements, and individual variations develop, modifying basic copybook forms into unique personal handwriting.

CHAPTER 25

Forgery Detection, Ink and Paper Examination

1. Under criminal law provisions, which of the following best describes the core legal definition of forgery?
(A) Making a false document or electronic record to cause damage or injury to any person
(B) The physical act of writing on a blank sheet of paper without prior authorization or permission
(C) The deliberate process of modifying a written document to correct minor grammatical errors
(D) The unauthorized possession or temporary holding of someone else's original legal document

2. A forensic expert examines a signature that was created by placing a genuine signature over a light source, placing the fraudulent document on top, and drawing over the outline. What type of forgery is this?
(A) Freehand simulated signature forgery
(B) Direct spurious signature forgery
(C) Transmitted light forgery
(D) Carbon-paper traced signature forgery

3. Which technique is most commonly utilized in a forensic laboratory as a non-destructive preliminary method to detect chemical erasures on a questioned document?
(A) Ultraviolet (UV) fluorescence examination
(B) High-Performance Liquid Chromatography (HPLC)
(C) Thin Layer Chromatography (TLC)
(D) Scanning Electron Microscopy (SEM)

4. Consider the following statements regarding erasures in documents:
I. Mechanical erasures involve removing ink using an abrasive material like a rubber eraser or razor blade.
II. Chemical erasures physically scrape away the upper layer of paper fibers to remove the writing.
III. Chemical erasures alter the chemical structure of the ink, often making it colorless without significantly disturbing the paper fibers.
Which of the above statements is/are correct?
(A) I and II are correct
(B) I and III are correct
(C) II and III are correct
(D) I, II, and III are correct

5. When a mechanical erasure is performed on a document using a sharp blade, what is the most noticeable physical change observed under a stereomicroscope?
(A) Presence of chemical bleaching residues
(B) Disruption and lifting of the paper fibers
(C) A localized area of intense UV fluorescence
(D) Change in the watermarking pattern

6. In questioned document terminology, what does the term "obliteration" refer to?
(A) The chemical bleaching of written ink to render it entirely invisible
(B) The technological process of copying a document using a high-resolution scanner
(C) Masking original writing by smearing or stamping over it
(D) The physical tearing of an entire legal document into small destroyed pieces

7. A document examiner is tasked with deciphering original writing that has been obliterated by an overlying layer of black marker ink. Which of the following techniques is most likely to succeed if the two inks have different chemical compositions?
(A) Transmitted visible light micro-examination
(B) Specialized oblique light photo-analysis
(C) Electrostatic Detection Apparatus processing
(D) Infrared (IR) luminescence photography

8. Given below are two statements, one labeled as Assertion (A) and the other labeled as Reason (R):
Assertion (A): Infrared (IR) luminescence

Downloaded from www.pdf.tube

document examiners to decipher indented text clearly.

47. (C) The continuous lines joining adjacent letters within a single word
Connecting strokes in cursive writing are continuous ink lines that link adjacent letters within a word. These strokes reflect natural muscular fluency and motor coordination developed over years of writing practice. Document examiners evaluate connecting stroke mechanics, inclination, and pressure shifts because they represent habituated individual habits that are difficult to disguise or copy.

48. (D) Tremor, irregular alignment, and degraded line quality
Severe physical illness weakens neuromuscular control, impairing fine motor execution during writing. This physiological deterioration produces persistent pathological tremors, unstable baseline alignment, uneven pen pressure, and severely degraded line quality. However, unlike fraudulent forgery attempts, illness-related deterioration manifests consistently across strokes and words without localized hesitation or intentional drawing features.

49. (B) I and III only
Forensic analysis of thumb impressions utilizes optical magnifiers and ridge counters to evaluate individual friction ridge details. Structural features such as cores, deltas, and minutiae patterns are vital for comparison, making statement II false. Excess ink or smudging obscures ridge details, validating statement III alongside statement I as correct forensic findings.

50. (B) Tremor of fraud shows misplaced hesitation, while tremor of age is generally consistent throughout strokes
Distinguishing between fraudulent tremor and physiological tremor relies on examining stroke consistency. A tremor of fraud exhibits unnatural hesitations, uneven pen stops, and ink blobbing at non-standard stroke locations caused by slow, deliberate copying. In contrast, a tremor of age shows persistent, involuntary, and uniform muscular instability across all written strokes.

51. (D) The height of lowercase letters lacking ascenders or descenders
The x-height in handwriting analysis represents the vertical height of lowercase letters that do not possess ascenders or descenders, such as ‘a’, ‘c’, ‘e’, and ‘x’. It establishes the baseline body height for writing. Examiners evaluate x-height ratios relative to ascenders and descenders to determine unique individual proportional habits.

52. (A) Chronological stroke order to detect document alterations
Determining the sequence of intersecting strokes is critical for establishing whether text was added before or after another entry on a document. Microscopic analysis of stroke intersections evaluates ink sheen, fiber distortion, and drag lines to identify which line was written last, providing objective evidence regarding potential document alterations or additions.

53. (C) Section 45
Under Section 45 of the Indian Evidence Act, opinions of skilled individuals upon points of foreign law, science, art, or identity of handwriting and finger impressions are relevant facts. Forensic document examiners present technical evidence, comparative analysis, and expert testimony in legal proceedings under this statutory provision to assist courts in evaluating questionable writings.

54. (A) Spurious forgery
A blind forgery is synonymous with a spurious forgery, occurring when a forger creates a signature without having seen or referenced a genuine model. The perpetrator simply writes the target name using their own handwriting or an invented design, resulting in a signature that lacks any stylistic resemblance to the victim’s authentic signature.

55. (D) Transmitted light shining from beneath the paper
Transmitted light illumination involves directing light through the back of a paper substrate toward the observer. In a Video Spectral Comparator, transmitted light reveals internal paper structures, watermarks, security threads, mechanical erasures, and physical tears. By shining light through the paper, physical density variations become clearly visible during non-destructive forensic examination.

NODIA

56. (A) P-3, Q-1, R-2, S-4
Simulated forgery features drawing-like execution and unnatural pauses while copying a model. Traced forgery displays physical guideline

evidence, such as carbon marks or indented grooves. Spurious forgery bears no stylistic resemblance to authentic signatures. A guided signature exhibits drastic line quality changes and dual writing impulses resulting from two people holding the pen.

57. (C) The placement, length, and slant of the t-bar crossing
The lowercase letter 't' provides significant individual characteristics through its horizontal crossbar execution. While the basic vertical stem is standard copybook instruction, the placement height, stroke length, slant, pressure, and whether the bar connects to adjacent letters reflect subconscious personal habit. These variations serve as valuable features during comparative handwriting analysis.

58. (D) Suppress automatic writing habits while adopting new conscious ones
Disguised writing creates internal motor conflict because the writer must consciously suppress subconscious, automatic writing habits while actively adopting unnatural structural forms. Maintaining this conscious control requires intense mental effort, which slows writing speed, disturbs stroke rhythm, causes hesitation marks, and leads to the gradual re-emergence of natural individual habits in longer documents.

59. (A) Samples taken from pre-existing personal or official records
Collected standards consist of pre-existing writing specimens executed during normal daily activities, business transactions, or official record-keeping prior to litigation. Because these samples were produced without knowledge of future forensic comparison, they accurately portray the subject's natural handwriting habits, stroke speed, and variation range without any risk of deliberate disguise.

60. (A) Conscious attention to letter forms → Repetition and practice → Subconscious/ automatic writing habit
Handwriting development progresses from initial conscious effort to subconscious automation. A beginner initially focuses conscious attention on copying letter shapes. Through continuous repetition and motor practice, these letter forms become habituated. Eventually, writing transforms into a subconscious, automatic motor habit where brain control shifts from visual monitoring to automatic motor execution.

61. (B) Parkinson's disease
Micrographia is a neurological manifestation commonly associated with Parkinson's disease, characterized by progressive reduction in letter size during writing. Basal ganglia impairment reduces motor amplitude, causing handwriting to start at normal size but diminish into small, crowded, and illegible script. Forensic examiners evaluate micrographia when analyzing health-induced personal handwriting modifications.

62. (A) I and II only
Signatures evolve over time, simplifying into stylized movements executed at higher speeds than routine text writing, making statements I and II true. Statement III is false because genuine writing always contains natural variation. Statement IV is incorrect as illiterate writers typically use thumb impressions rather than standardized artistic personal signatures.

63. (C) Simulated or traced forgery
Unnatural pen lifts occurring within continuous letter strokes or connected words are strong indicators of simulated or traced forgery. During fraudulent execution, the forger pauses to verify alignment, check the model signature, or readjust their pen placement. These interruptions disrupt natural fluency, creating unexpected pen lifts and blunt stroke re-entry points.

64. (D) The horizontal distance between two consecutive words
Inter-word spacing refers to the horizontal spatial distance separating consecutive words along a line of writing. Spacing habits develop as part of an individual's spatial organization and rhythm. Examiners measure inter-word spacing alongside inter-letter and inter-line spacing, as consistent spatial distribution forms a reliable individual characteristic in forensic handwriting comparison.

65. (C) Slower, uncertain stroke execution causing ink pooling or tremor
Hesitation in document examination represents a momentary slowdown or pause in writing motion without lifting the pen from paper. Uncertain execution causes ink to pool on paper fibres and introduces localized stroke wobble or tremor. Hesitation marks frequently occur in forgeries

Click Here to Buy book on Flipkart

because perpetrators write with reduced speed while copying complex model forms.

66. (B) It contains every letter of the alphabet for a comprehensive sample
The sentence "The quick brown fox jumps over the lazy dog" is a classic pangram containing all twenty-six letters of the English alphabet. Dictating pangrams during handwriting standard collection ensures examiners acquire comprehensive writing specimens containing every capital and lowercase character, enabling thorough comparative analysis of letter construction across standard and questioned samples.

67. (D) Disguise
Writing with the unaccustomed non-dominant hand is an intentional method of disguise designed to conceal identity. Using the non-dominant hand disrupts established fine motor control, producing uncoordinated strokes, erratic baseline alignment, and degraded line quality. However, fundamental individual habits, spelling quirks, and spatial arrangements often remain detectable under expert examination.

68. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Relying on only one or two standard signatures is inadequate for forensic comparison because human handwriting possesses natural variation. A single specimen fails to capture the full spectrum of permissible variation in slant, letter height, speed, and spacing. Collecting multiple standard specimens ensures document examiners establish a comprehensive natural variation baseline for reliable comparative evaluation.

69. (C) Subconscious connecting strokes and letter proportions
Subconscious features like connecting strokes and letter proportions are executed automatically without conscious visual monitoring. While writers can easily alter superficial features such as writing slant, capital letter size, or signature flourishes, deeply ingrained neuromuscular habits controlling character ratios and connecting movements consistently persist, enabling examiners to detect disguised handwriting.

70. (A) Words drop progressively, creating a descending staircase alignment
Stepped baseline alignment occurs when individual words slant upward or horizontally, but each successive word begins at a lower position than the preceding one. This movement produces a progressive descending staircase pattern across the page. Stepped alignment reflects personal spatial organization habits and wrist placement adjustments during continuous sentence writing.

71. (D) Video Spectral Comparator
VSC stands for Video Spectral Comparator, a specialized laboratory imaging instrument widely utilized in forensic document analysis. It integrates high-resolution cameras, various light sources ranging from ultraviolet to infrared, and spectral filters. Examiners use VSC systems to detect document alterations, differentiate inks, reveal erased text, and verify embedded security features.

72. (B) Small closed loops in letters such as 'a', 'e', or 'o'
Eyelets, also termed eyelet formations or small loops, refer to tiny enclosed loops created within the body strokes of letters like 'a', 'e', 'o', 'd', or 'g'. Formed by subconscious pen movements and specific stroke directions, eyelet dimensions and locations represent highly consistent individual traits that assist examiners during handwriting comparisons.

73. (C) Standards must feature matching letters, words, and text combinations
Comparability requires that collected or requested handwriting standards contain the same letters, letter combinations, words, and structural arrangements as those present in the questioned document. Comparing identical characters and combinations ensures document examiners evaluate matching contextual habits, stroke connections, and spatial relationships rather than attempting to compare entirely different alphabetical characters.

74. (D) Count ridges from the core to the delta
Ridge counting in fingerprint examination is a standardized quantitative procedure performed on loop patterns. The count begins at the point of core focal origin and proceeds along an imaginary line directly to the delta point, excluding both the core and delta points from

Downloaded from www.pdf.tube

18. (B) Disguised writing
Disguised writing occurs when an individual intentionally alters their natural handwriting habits to hide identity and prevent attribution. Common methods of disguise include changing writing slant, adopting block capital letters, modifying letter size, or using the non-dominant hand. Despite deliberate modifications, underlying subconscious individual habits frequently persist throughout extended writing samples.

19. (A) P-2, Q-1, R-3, S-4
Rhythm refers to the harmonious recurrence of motion, stress, and spacing during writing execution. Slant denotes the angle of inclination of writing strokes relative to the baseline. Proportion defines the relative size relationships among different letters or structural components. Speed represents the rapidity of execution, influencing line smoothness, stroke tapering, and pressure patterns.

20. (A) Unnatural pen lifts and blunt endings
Simulated or freehand forgery involves copying a genuine model signature through deliberate drawing movements. Because the forger continuously checks the model while writing, the resulting strokes suffer from diminished speed and fluency. Key diagnostic indicators include unnatural pen lifts, blunt initial and terminal strokes, ink blobbing, hesitations, and erratic tremor along line edges.

21. (C) Stereomicroscope
A stereomicroscope provides binocular, low-power magnification with enhanced depth perception, making it ideal for examining physical document features. It enables examiners to analyze line continuity, paper fiber disturbance, physical erasures, ink sheen, and stroke sequence at intersection points by revealing which ink stroke layer physically rests above the other under specialized illumination.

22. (A) Invisible or faint, needing chemical or physical development
A latent impression is an invisible or faint mark transferred onto paper by sweat, natural skin oils, or fine residues present on friction ridge surfaces. Because latent prints cannot be evaluated clearly with the unassisted eye, forensic processing using physical powders or chemical reagents is necessary to visualize ridge details for comparative analysis.

23. (D) The mental image of a letter form that a writer subconsciously executes
In writing theory, a master pattern refers to the subconscious mental image or motor schema of characters stored in an individual's brain. Developed through practice and habit, this mental blueprint guides motor execution. Although natural variations occur during writing, motor impulses consistently aim to recreate this internalized master pattern across consecutive executions.

24. (B) It produces larger, careless, and significantly less legible writing
Severe alcohol intoxication impairs central nervous system functioning and fine motor coordination. This loss of fine motor control usually manifests in handwriting as an increase in letter size, irregular baseline alignment, coarse line quality, jerky stroke movements, and degraded legibility. Despite these gross physical disturbances, fundamental individual habits are rarely lost completely.

25. (C) The line quality and baseline alignment
Writing on an unstable or unaccustomed surface, such as against a rough wall, introduces external mechanical distortion into the writing stroke. Physical obstacles degrade fine motor precision, leading to erratic line quality, unnatural tremor, and distorted baseline alignment. However, linguistic habits, spelling choices, and core structural forms remain unaffected by surface irregularities.

26. (B) I and III only
Altering handwriting slant and executing writing with the unaccustomed, non-dominant hand are common techniques used to disguise personal handwriting. However, maintaining disguised writing consistently across extended text is difficult due to subconscious habit re-emergence. Furthermore, disguised writing involves deliberate, slow motor control, resulting in lower execution speeds rather than higher speeds.

27. (A) Dictate the text at varying speeds without showing the questioned document
When collecting requested handwriting standards, investigators dictate text containing comparable words at varied speeds while

NODIA

84. (A) Stopping the pen abruptly rather than lifting it in motion
Blunt terminal strokes occur when a writer abruptly halts pen movement on the paper surface before lifting the instrument, resulting in a heavy, rounded ending. In natural, high-speed handwriting, terminal strokes taper off smoothly as the pen lifts during motion. Blunt endings in questioned signatures typically indicate slow, deliberate forgery or artificial copying movements.

85. (B) 2, 3, 4, 1
Handwriting characteristics range from general class traits to highly specific individual features. The broadest level is the regional copybook system taught during basic education. Next are family or group stylistic influences. Finer analysis considers subconscious natural variations within a writer's style. Finally, unique individual peculiarities represent the most specific features for forensic identification.

86. (A) A neuromuscular disease suffered by the writer
Intrinsic factors affecting handwriting originate within the writer's physical and neurological state. A neuromuscular disease directly impairs internal motor control, muscular strength, and nervous signal transmission, affecting stroke fluency, speed, and baseline stability. Conversely, writing instruments, paper substrate, and room lighting represent external extrinsic environmental variables that influence writing output from outside the individual.

87. (C) Assertion (A) is true but Reason (R) is false.
Forensic handwriting experts present opinion testimony under relevant statutory rules, subjecting their findings to cross-examination in court. However, handwriting examination is an applied forensic discipline based on comparative principle analysis rather than an exact physical science like chemical spectroscopy. Human factors introduce potential margins of error, making Reason R false while Assertion A is true.

88. (B) Cut-and-paste (composite) forgery
A cut-and-paste or composite forgery is constructed by harvesting individual letters or signature segments from multiple authentic documents and assembling them to construct a target signature. The composite assembly is then photocopied or digitally scanned to produce a seamless image, hiding physical paper cut edges while retaining genuine individual letter forms.

89. (A) I, II and IV only
Simplistic signatures lacking adequate stroke complexity prevent examiners from forming definitive conclusions, validating statement I. Over-relying on general class characteristics leads to erroneous positive identifications, supporting statement II. Stereomicroscopes afford 3D depth perception for stroke sequence evaluation, validating IV. Statement III is false because age and gender cannot be determined solely from handwriting.

90. (A) P-3, Q-2, R-4, S-1
Positive identification means standard and questioned writings were definitely written by the same individual. Probable opinion indicates strong supporting evidence that falls short of absolute certainty. Inconclusive opinion means available evidence is insufficient to evaluate common authorship. Elimination confirms standard and questioned writings were definitely executed by different human individuals.

www.nodia.in

Click Here to Buy book on Amazon

the final tally. This numerical count provides a reliable class metric for pattern evaluation.

75. (A) Personal copybook deviations unique to a specific writer
Individual characteristics in handwriting analysis are unique habits and deviations from standard copybook systems developed by a specific writer over time. These features include unique stroke starts, unusual proportion ratios, peculiar t-bar crossings, specific pen pressure variations, and specialized connecting flourishes. The combination of multiple individual characteristics enables conclusive identification of writing authorship.

76. (B) Letter portions extending below the baseline (e.g., in g, j, p, y)
A descender is the portion of a lowercase letter that extends downward below the baseline, as observed in letters like 'g', 'j', 'p', 'q', and 'y'. Forensic document examiners analyze descender loop length, shape, angle, stroke width, and pressure distribution, because descender formations represent highly habituated individual characteristics during comparative handwriting analysis.

77. (A) I and II only
Charred documents are extremely fragile and susceptible to crumbling, requiring careful handling and preservation, validating statement I. Deciphering writing on charred documents utilizes non-destructive techniques like oblique lighting and infrared photography, making statement II correct. Applying liquid chemical ink solvents directly onto charred paper destroys delicate evidence, rendering statement III false.

78. (A) A document written and signed entirely in one author's hand
A holographic document is defined as a document, such as a deed or will, that is written and signed entirely in the handwriting of its author. Because holographic documents contain extensive handwritten text executed by a single individual, they provide document examiners with abundant individual characteristics and natural variation for forensic handwriting authentication.

79. (B) II and III only
Class characteristics alone cannot establish positive identification because they are shared by multiple individuals who learned the same writing system, making statement I incorrect. A positive identification requires evaluating a unique combination of multiple individual characteristics. Unexplained fundamental differences between questioned and standard samples indicate different authors, validating statements II and III.

80. (D) Writers know samples are collected and may intentionally disguise writing
The primary limitation of requested handwriting standards is that subjects are fully aware their writing is being sampled for forensic examination. This awareness creates an opportunity for subjects to intentionally alter or disguise their natural writing style. To counter this limitation, investigators dictate text at varying speeds and collect multiple requested specimens alongside pre-existing collected standards.

NODIA

81. (C) Exact dimensions, spacing, and letter sizes of writing
A forensic magnifying glass fitted with a calibrated glass scale, such as a reticle or micrometer grid, is designed for precise physical measurements. Document examiners utilize this instrument to measure exact letter heights, stroke widths, character proportions, inter-word spacing, and slant angles, providing objective quantitative data to compare disputed handwriting against standard reference samples.

82. (B) Traced forgery
A questioned signature displaying drawing-like execution, lack of stroke fluidity, blunt ends, and exact mathematical congruence with a genuine model signature upon superimposition is a traced forgery. Human writing naturally contains variation, making exact duplicate signatures physically impossible. Superimposition alignment proves the signature was directly copied from the model using a tracing technique.

83. (A) P-3, Q-4, R-1, S-2
A magnifying glass is used for basic field observation of line quality. A stereomicroscope provides three-dimensional observation of paper fibers and intersecting strokes. ESDA decodes latent indented writing on paper without physical damage. The Video Spectral Comparator differentiates inks using selective infrared and ultraviolet light absorption and luminescence emission properties.

can differentiate between the original ink and the obliterating ink if they have different dye compositions.
Reason (R): Different inks, even if they appear identical in visible light, may absorb and reflect infrared radiation differently.
In light of the above statements, choose the correct answer from the options given below:
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(B) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

9. An addition made to a document by inserting words or lines between previously written lines is technically known as:
(A) Erasure
(B) Interlineation
(C) Tracing
(D) Obliteration

10. Which of the following is the most conclusive indicator that page substitution has occurred in a multi-page legal contract?
(A) The presence of a genuine signature appearing exclusively on the last page
(B) Discrepancies in paper thickness, watermark, or staple holes on one page
(C) Consistent staple hole alignments and uniform page dimensions across all pages
(D) The consistent use of identical black ballpoint ink throughout all pages

11. Indented writings on a document are best described as:
(A) Paper fiber depressions caused by writing pressure on an overlying sheet
(B) Document writings that have been chemically bleached using oxidizing agents
(C) Secret or invisible writings created through the application of biological fluids
(D) Historical writings where ink has migrated deeply into paper fibers over time

12. The Electrostatic Detection Apparatus (ESDA) is highly effective at developing indented writing. What is the fundamental mechanism it utilizes?
(A) It detects micro-chemical differences and compositional variations within the underlying ink residues.
(B) It uses high-precision infrared lasers to measure subtle microscopic variations in local paper thickness.
(C) It uses corona discharge to create an electrostatic image attracting toner to paper stress areas.
(D) It employs specialized iodine fuming techniques to react with sizing agents inside paper indentations.

13. Match the secret writing ink in List I with its corresponding development method/reagent in List II:
List I: (Secret Writing Ink)
P. Lemon juice (organic)
Q. Starch solution
R. Phenolphthalein solution
S. Ferrous sulfate solution
List II: (Development Method/Reagent)
1. Iodine vapor/solution
2. Dilute alkali (e.g., sodium hydroxide)
3. Application of heat
4. Potassium ferricyanide solution
(A) P-3, Q-1, R-2, S-4
(B) P-1, Q-2, R-3, S-4
(C) P-3, Q-2, R-1, S-4
(D) P-2, Q-1, R-4, S-3

14. Which of the following is the most appropriate method for transporting highly fragile charred documents recovered from an arson scene to the forensic science laboratory?
(A) Folding the brittle documents and placing them inside a standard paper envelope
(B) Sealing them tightly in a plastic zip-lock bag and fully extracting all air
(C) Placing them in a rigid padded container to prevent movement
(D) Immersing them completely inside a sealed container filled with distilled water

15. A forensic document examiner may apply a fine mist spray to brittle, charred documents to impart flexibility and prevent them from crumbling. What chemical solution is standardly used for this purpose?
(A) Concentrated sulfuric acid prepared in an organic solvent medium
(B) A dilute polyvinyl acetate or water-glycerine-alcohol solution
(C) Ninhydrin reagent dissolved in a suitable acetone carrier solvent
(D) Silver nitrate reagent dissolved thoroughly in distilled water

Downloaded from www.pdf.tube

16. Consider the following steps for developing indented writing using an Electrostatic Detection Apparatus (ESDA):
I. Apply the cascade developer (glass beads and toner) over the surface.
II. Humidify the questioned document to increase its moisture content.
III. Place a thin Mylar polymer film over the document.
IV. Apply an electrostatic charge using a corona wand.
Which of the above steps represent the correct sequential order?
(A) II, III, IV, I
(B) III, II, IV, I
(C) II, IV, III, I
(D) IV, II, III, I

17. When examining torn and mutilated documents, achieving a "physical match" or "jigsaw fit" between the torn edges provides what level of forensic certainty regarding their common origin?
(A) Individual characteristic match
(B) Class characteristic match confirming broad material consistency
(C) Presumptive forensic match requiring further supportive evidence
(D) No forensic or evidentiary value in document comparison

18. Faded ink on historical documents can often be deciphered non-destructively using which of the following techniques?
(A) Thin Layer Chromatography chemical separation
(B) Iodine fuming vapor development technique
(C) Ultraviolet (UV) and Infrared (IR) imaging
(D) High-Performance Liquid Chromatography analysis

19. If a batch of documents is recovered fully submerged in water and cannot be dried immediately at the laboratory, what is the best temporary preservation method to prevent mold growth and further deterioration?
(A) Freezing them until they can be properly freeze-dried
(B) Flat ironing them thoroughly using direct high temperature heat
(C) Leaving them unattended in a warm, dark, unventilated room
(D) Spraying them thoroughly with a strong concentrated bleach solution

NODIA

20. Consider the following statements regarding the decipherment of charred documents:
I. Reflected infrared photography can sometimes differentiate charred ink from charred paper.
II. Oblique lighting is useless for examining charred documents because they are entirely black.
III. Chemical treatment with silver nitrate can develop writing on charred paper if the original ink contained chlorides or reducible metal salts.
IV. Charred documents shrink significantly and become highly brittle, making physical manipulation dangerous.
Which of the above statements is/are incorrect?
(A) I and III only
(B) II only
(C) III and IV only
(D) II and IV only

21. When determining the sequence of intersecting strokes (where a ballpoint pen line crosses a fountain pen line), which observation strongly indicates that the ballpoint pen line was written last?
(A) The fluid ballpoint pen ink visibly bleeds and diffuses into the fountain pen line.
(B) The continuous ballpoint furrow passes uninterrupted across the fountain pen line.
(C) The fountain pen ink is completely and uniformly absorbed into the underlying paper fibers.
(D) The fountain pen line shows distinct skipped areas directly where it crosses the ballpoint ink.

22. If a document is folded after it has been written upon, what microscopic characteristic is generally observed at the fold line?
(A) The writing ink line remains entirely continuous, smooth, and perfectly undisturbed.
(B) The writing ink will permanently change its chemical color to a lighter shade at the fold.
(C) Paper fibers crack at the fold, disrupting ink and causing particles to flake off.
(D) The physical fold permanently creates a clear, distinct synthetic watermark in the paper.

23. What is the difference between "absolute age" and "relative age" of a document?
(A) Absolute age is determined by paper fibers;

relative age is determined solely by ink chemistry.
(B) Absolute age relies strictly on witness testimony; relative age relies on chemical ink analysis.
(C) Absolute age determines time since death; relative age determines time since forgery occurred.
(D) Absolute age is the creation date; relative age establishes the sequence of entries.

24. Iron gallotannate ink, commonly used in historical documents, undergoes a gradual color change over time. This aging process involves:
(A) Oxidation of ferrous to ferric compounds, darkening the ink to a permanent black/brown color.
(B) The reduction of ferric ions into ferrous ions, rapidly changing ink color from brown to blue-black.
(C) The gradual evaporation of metallic iron particles, leaving only soluble organic tannins behind.
(D) The direct transformation of soluble dye molecules into insoluble pigments through UV exposure.

25. Given below are two statements, one labeled as Assertion (A) and the other labeled as Reason (R):
Assertion (A): The relative age of ballpoint pen ink on a document can sometimes be estimated by measuring the extraction rate of the ink in a solvent.
Reason (R): As ballpoint pen ink ages on paper, the resinous binders polymerize and harden, causing the ink to extract more slowly into a solvent compared to fresh ink.
In light of the above statements, choose the correct answer from the options given below:
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(B) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

26. Which of the following correctly describes a fundamental difference between dye-based inks and pigment-based inks?
(A) Dyes consist of solid particles suspended in a vehicle, whereas pigments are fully dissolved liquid components.
(B) Dyes are dissolved in the liquid vehicle, while pigments are suspended solid particles.
(C) Pigment-based ink formulations always degrade and fade faster than dye-based inks when exposed to solar light.
(D) Dye-based inks are restricted to ballpoint pens, whereas pigment-based inks are restricted to fountain pens.

27. Gel pen inks often present unique challenges in questioned document examination. What is the typical vehicle used in modern gel inks?
(A) A water-based gel thickened with biopolymers
(B) A high-viscosity mineral oil base formulation
(C) A fast-drying volatile alcohol solvent mixture
(D) A volatile toluene or xylene chemical solvent

28. Which type of ink is characterized by a very thick, highly viscous consistency, often using varnishes and linseed oil as a vehicle, and is primarily transferred by mechanical pressure?
(A) Fountain pen ink
(B) Fiber-tip pen ink
(C) Printing ink
(D) Rollerball pen ink

29. The Video Spectral Comparator (VSC) is a standard instrument in forensic document examination. Which of the following parameters does it NOT directly analyze?
(A) Ultraviolet fluorescence of paper and inks
(B) Infrared absorption and luminescence of inks
(C) Microscopic features under oblique, transmitted, and coaxial lighting
(D) The exact chemical molecular weight of the ink dyes

30. Consider the following statements regarding the Video Spectral Comparator (VSC):
I. It is a destructive analytical technique.
II. It allows for real-time visualization of different ink responses under various wavelengths of light.
III. It can effectively reveal obliterated writings if the covering ink is transparent to IR light while the underlying ink absorbs it.
Which of the above statements is/are correct?
(A) I and II
(B) II and III
(C) I and III
(D) I, II, and III

Click Here to Buy book on Flipkart

(B) A strong acid solution such as HCl
(C) A neutral sodium chloride saline solution
(D) Pure deionized distilled water

84. When examining a chemically erased area on a cheque under ultraviolet (UV) light, why does the erased spot often appear as a dark or contrasting patch against the rest of the paper?
(A) The bleaching chemicals create dense heavy metal deposits that actively absorb ultraviolet light.
(B) Chemical erasers turn all underlying paper cellulose fibers directly into pure elemental carbon.
(C) The applied UV light creates a violent photochemical reaction with ambient atmospheric oxygen.
(D) Erasing chemicals destroy or alter optical brightening agents (OBAs) in that area.

85. When comparing oblique light photography with Electrostatic Detection Apparatus (ESDA) for the detection of indented writing, which statement is most accurate?
(A) Oblique lighting is generally far more sensitive than ESDA for detecting indentations several pages deep.
(B) ESDA is more sensitive, detecting indentations several pages beneath writing.
(C) ESDA inherently destroys the original paper document, whereas oblique side lighting is non-destructive.
(D) Both detection techniques strictly require the questioned document to be chemically treated beforehand.

86. Determining the relative age of intersecting strokes (ink over ink) can be complicated or impossible if:
(A) Both intersecting lines were written using standard commercial ballpoint pen ink formulations.
(B) Both intersecting lines were written using water-based liquid fountain pen ink formulations.
(C) Strokes occurred while the first ink was wet, causing bleeding and mixing.
(D) The questioned document substrate is older than one year from its claimed creation date.

87. A multi-page will is suspected of having a substituted page. The examiner notices that page 3 has three sets of staple holes in the top left corner, while pages 1, 2, and 4 only have one set. What is the most logical forensic conclusion?
(A) Page 3 was printed using a completely different desktop printing device than the remaining pages.
(B) Page 3 was executed and written using an entirely different writing instrument or ink type.
(C) Page 3 is demonstrably older than all the other pages of the contract by exactly ten years.
(D) Page 3 was un-stapled and re-stapled more often, suggesting tampering or substitution.

NODIA

88. Microscopic examination of ballpoint pen writing typically reveals specific mechanical characteristics. Which of the following is a classic characteristic of ballpoint pen strokes?
(A) Ink skipping, gooping at direction changes, and stroke striations
(B) Perfectly uniform liquid ink distribution with absolutely no natural variation in density
(C) Pronounced liquid wicking and feathering of ink along the porous paper substrate fibers
(D) Complete physical absence of any mechanical line indentation on the paper substrate

89. The formula to calculate the Retention factor (Rf) in Thin Layer Chromatography (TLC) of inks is:
(A) Distance traveled by solvent front / Distance traveled by solute spot
(B) Distance traveled by solute spot / Distance traveled by solvent front
(C) Distance traveled by solute spot $\times$ Distance traveled by solvent front
(D) Distance traveled by solvent front - Distance traveled by solute spot

90. The foundational principle behind questioned document examination and the identification of forgery is derived from which broader forensic concept?
(A) The physical principle of progressive change
(B) The principle of individuality
(C) The fundamental law of conservation of mass
(D) The physical Heisenberg uncertainty principle

(A) Distilled water
(B) Hexane
(C) Concentrated hydrochloric acid
(D) Pyridine or Methanol

40. Given below are two statements, one labeled as Assertion (A) and the other labeled as Reason (R):
Assertion (A): It is sometimes possible to determine the exact manufacturing year of a specific ink on a document using ink tags.
Reason (R): Some ink manufacturers voluntarily add specific rare-earth elements or fluorescent chemical markers, changing them annually to serve as dating tags.
In light of the above statements, choose the correct answer from the options given below:
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(B) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

41. In the manufacturing of paper, which process produces pulp with higher lignin content, resulting in paper that yellows and degrades more quickly (like newsprint)?
(A) Chemical pulping via the Kraft process
(B) Mechanical groundwood pulping
(C) Industrial chemical bleaching process
(D) Internal chemical sizing process

42. What is the primary function of adding sizing agents to paper during its manufacture?
(A) To substantially increase the surface whiteness and brightness of paper
(B) To reduce liquid penetration and prevent ink feathering or bleeding
(C) To give the finished paper sheets specific standardized dimensions
(D) To create a distinctive visual watermark directly within paper fibers

43. Which of the following compounds is a traditional sizing agent commonly detected in older paper documents?
(A) Rosin precipitated with alum
(B) Titanium dioxide pigment powder
(C) Kaolin clay filler material
(D) Calcium carbonate mineral filler

44. Fillers are added to paper to improve its opacity, weight, and printing surface. Which of the following is a widely used paper filler?
(A) Cellulose acetate
(B) Sodium chloride
(C) Kaolin (China clay)
(D) Polyvinyl chloride

45. Consider the following statements regarding paper composition:
I. Cellulose fibers form the primary structural matrix of paper.
II. Titanium dioxide is added to paper to decrease its brightness.
III. Internal sizing is added to the pulp before the paper sheet is formed.
IV. The presence of optical brighteners causes paper to fluoresce under UV light.
Which of the above statements are correct?
(A) I, II, and III
(B) I, III, and IV
(C) II, III, and IV
(D) I, II, and IV

46. In the papermaking process, what equipment is specifically responsible for impressing a true watermark into the wet paper web?
(A) The Fourdrinier wire
(B) The Calender rollers
(C) The Dandy roll
(D) The Hollander beater

47. An artificial (simulated) watermark is created by printing a design onto the surface of finished paper using oils or clear inks. How does an artificial watermark typically behave when examined under a microscope compared to a true watermark?
(A) It exhibits a distinct local variation in fiber density, identical to a true watermark.
(B) It sits on the surface without causing true fiber displacement.
(C) It can only be visualized and examined when placed under specialized infrared light.
(D) It substantially increases the overall measured thickness of the paper sheet by 5 mm.

48. What precision instrument is standardly used in forensic document laboratories to measure the thickness of a paper sheet?
(A) Digital Vernier caliper
(B) Reflectance spectrophotometer
(C) Optical densimeter

NODIA

(D) Precision micrometer gauge

49. The opacity of a sheet of paper refers to:
(A) Its ability to transmit light through its thickness
(B) The degree to which it fluoresces under UV radiation
(C) Its resistance to tearing and folding
(D) The weight of the paper in grams per square meter (GSM)

50. Consider the following fundamental steps of modern machine-made paper production:
I. Beating and refining the pulp
II. Forming the sheet on a continuous wire mesh (Fourdrinier)
III. Chipping and pulping the raw wood material
IV. Drying and calendering the formed paper sheet
Which of the above steps represent the correct sequential order?
(A) III, I, II, IV
(B) I, III, II, IV
(C) III, II, I, IV
(D) I, II, III, IV

51. When a forensic analyst conducts a fiber analysis of paper, they often use a chemical stain. The Herzberg stain yields a wine-red color for which type of fibers?
(A) Rag fibers
(B) Mechanical wood pulp fibers
(C) Chemical wood pulp fibers
(D) Synthetic nylon polymer fibers

52. Match the paper fiber testing stain in List I with its primary characteristic or use in List II:
List I: (Paper Fiber Testing Stain)
P. Herzberg stain
Q. Phloroglucinol stain
R. Iodine solution
S. Ultraviolet light
List II: (Primary Characteristic/Use)
1. Detects the presence of starch sizing
2. Detects the presence of optical brightening agents
3. General fiber identification (Zinc chloro-iodide)
4. Turns magenta/red in the presence of lignin (mechanical pulp)
(A) P-3, Q-4, R-1, S-2
(B) P-4, Q-3, R-2, S-1
(C) P-3, Q-1, R-4, S-2
(D) P-1, Q-2, R-3, S-4

53. If a questioned document fluoresces brightly under ultraviolet (UV) light, it most likely indicates the presence of:
(A) High lignin chemical content present in the raw paper pulp
(B) Optical Brightening Agents (OBAs)
(C) Surface contamination containing traces of human blood
(D) Historical iron gall ink residues left on the document

54. In typewriting examination, the term "escapement pitch" refers to:
(A) The total physical force with which a striking typebar impacts the rubber platen
(B) The precise vertical distance measured between consecutive lines of typed text
(C) The horizontal spacing, measured in characters per inch (cpi)
(D) The specific typographical font style or design family of the typewriter machine

55. A document examiner measures a typewritten document and determines there are exactly 12 characters per inch. This typeface size is classically known as:
(A) Pica
(B) Proportional
(C) Gothic
(D) Elite

56. What type of information can an examiner deduce by closely evaluating the thread impressions of a typewriter ribbon left on the typed paper?
(A) Whether a cloth ribbon or a carbon film ribbon was used
(B) The exact chronological age and manufacturing date of the typewriter
(C) The specific commercial brand of ink chemical formulation in the ribbon
(D) The individual machine serial number stamped onto the typewriter frame

57. The standard grid system utilizing a glass measuring plate to determine the vertical and horizontal alignment of typed characters is used to identify:
(A) The structural composition and manufacturing brand of the paper sheet
(B) Typeface defects in a specific typewriter
(C) The precise chronological sequence of intersecting written strokes
(D) The complete chemical composition of the electrophotographic toner

Downloaded from www.pdf.tube

58. Consider the following statements regarding typeface defects found in typewritten documents:
I. Horizontal misalignment occurs when a character prints to the left or right of its proper position.
II. "Off-its-feet" defect occurs when a character prints heavier on one side (top, bottom, left, or right) than the other.
III. A rebound defect occurs when the escapement mechanism fails entirely, causing all letters to print on top of one another.
Which of the above statements is/are correct?
(A) I and II
(B) I and III
(C) II and III
(D) I, II, and III

59. In typewriting, a secondary, faint impression of a character appearing slightly to the side of the main character due to the typebar bouncing against the platen is termed:
(A) Rebound
(B) Character overwriting
(C) Paper indentation
(D) Ink smudging

60. Given below are two statements, one labeled as Assertion (A) and the other labeled as Reason (R):
Assertion (A): Single-use carbon film typewriter ribbons are highly valuable as forensic evidence if recovered.
Reason (R): Each key struck removes a portion of the carbon film, leaving a readable, continuous negative record of everything typed using that ribbon.
In light of the above statements, choose the correct answer from the options given below:
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(B) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

61. Which of the following characteristics is a primary identifier of a document printed using a laser printer?
(A) The distinct presence of physical impact indentations on the back of the paper sheet
(B) Microscopic, scattered satellite ink droplets positioned around printed character edges
(C) A visible matrix of individually punched impact dots forming a ribbon pattern
(D) Polymer toner fused onto paper, appearing slightly raised and glossy

62. When examining a document under a stereomicroscope, you observe liquid ink that has wicked into the paper fibers, along with microscopic "satellite" droplets of ink sprayed around the edge of the printed letters. What produced this document?
(A) Laser printer
(B) Dot matrix printer
(C) Inkjet printer
(D) Typewriter

NODIA

63. A dot matrix printer generates characters by:
(A) High-velocity spraying of ionized droplets of liquid ink through a microscopic nozzle
(B) Striking a pin matrix head against an inked ribbon onto paper
(C) Fusing dry polymer toner powder directly onto paper using heat and pressure rollers
(D) Thermally evaporating solid colored wax ink formulations onto the paper substrate

64. "Trash marks" on a photocopied document are forensically significant because they:
(A) Definitively indicate that the substrate paper used was chemically recycled
(B) Provide conclusive proof that the original document text was chemically erased
(C) Accurately reveal the detailed chemical composition of the electrophotographic toner
(D) Help identify the copier through platen or optical system defects

65. Many modern color laser printers print a pattern of tiny, almost invisible yellow dots across the page. What is the primary purpose of these dots?
(A) To encode Machine Identification Codes (MIC) for anti-counterfeiting tracking
(B) To precisely align the individual primary color electrophotographic toner cartridges
(C) To significantly enhance and improve the overall visual resolution of printed images
(D) To effectively prevent the paper substrate from jamming inside the fuser roller assembly

66. Match the printing or reproduction technology in List I with its characteristic microscopic feature in List II:
List I: (Printing/Reproduction Technology)
P. Inkjet Printer

Q. Color Laser Printer
R. Typewriter
S. Photocopier

List II: (Characteristic Microscopic Feature)
1. Fused colored toner particles, often with a yellow tracking dot pattern
2. Splattered ink droplets and wicking along paper fibers
3. Trash marks from platen defects
4. Impact indentations and physical impression of the character block

(A) P-2, Q-1, R-4, S-3
(B) P-1, Q-2, R-3, S-4
(C) P-4, Q-3, R-2, S-1
(D) P-2, Q-3, R-4, S-1

67. If a questioned signature has been digitized using a flatbed scanner and subsequently printed, what microscopic feature might distinguish it from a genuine, liquid-ink signature?
(A) The signature will be composed of a matrix of discrete halftone or dithered dots.
(B) The written signature will display continuous, smooth, flowing furrows characteristic of a physical pen tip.
(C) The written signature deposit will consistently fluoresce a bright blue under all ultraviolet light wavelengths.
(D) The written signature line will always appear completely uniform black without any natural color variations.

68. A key difference used to distinguish a high-quality color photocopy of a document from the original document is:
(A) The high-quality photocopy will retain distinct physical impact indentations from the original writing pen.
(B) The reproduction copy will consistently be rendered slightly smaller in overall scale than the original.
(C) The reproduced document paper substrate will demonstrate a measurably lower chemical pH level.
(D) The photocopy lacks 3D ink deposits and physical paper indentations.

69. Consider the following statements regarding the comparison of laser and inkjet printing:
I. Laser printer text often sits on top of the paper fibers, while inkjet text absorbs into them.
II. Laser toner contains magnetic properties that can be detected, unlike standard inkjet dye.
III. Inkjet printing relies on heat and pressure to fix the liquid ink to the paper.
IV. The edge of an inkjet-printed line often appears fuzzier under high magnification compared to a crisp laser-printed edge.

Which of the above statements are correct?
(A) I, II, and III
(B) II, III, and IV
(C) I, II, and IV
(D) I, III, and IV

70. When counterfeit currency is produced using a commercial inkjet printer, what standard security feature is inherently impossible to replicate perfectly with this method?
(A) The exact dimensional size of the banknote
(B) The general overall color scheme and tint
(C) Intaglio (raised) printing
(D) The unique sequential serial numbers

71. Rubber stamps are primarily manufactured using two methods: vulcanization of natural rubber and:
(A) Molded iron casting
(B) Artistic glass blowing
(C) Metal electroplating
(D) Photopolymer curing

72. Which of the following provides individual characteristics useful for identifying a specific rubber stamp that produced a questioned impression?
(A) Wear, dirt, and specific cuts in the rubber die
(B) The specific chemical color of the ink in the stamp pad
(C) The standard commercial font type utilized across the stamp
(D) The overall rectangular geometric shape of the stamp border

73. When determining the sequence of intersecting strokes between a handwritten ballpoint pen line and a rubber stamp impression, which observation suggests the handwriting was placed AFTER the stamp?
(A) The ballpoint pen ink is repelled by stamp ink, causing visible line skipping.
(B) The ballpoint pen furrow cuts through the stamp ink layer.
(C) The fluid stamp ink flows deeply and continuously into the ballpoint pen furrow.
(D) The dense rubber stamp impression

Click Here to Buy book on Amazon

completely masks the underlying ballpoint line.

74. In cases of tampering with wax seals on envelopes, which of the following is a strong indicator of forgery or unauthorized opening?
(A) The distinct presence of a clear, unified friction ridge fingerprint impressed on the wax
(B) Irregular fracturing, remelting, or matrix design mismatching
(C) The physical wax formulation being characterized by a bright red overall color
(D) The physical matrix of the wax seal containing embedded cotton fiber inclusions

75. What is the most fundamental principle applied by document examiners when comparing handwriting to determine authorship?
(A) No two individuals write identically, and writing has natural variation.
(B) An individual's handwriting remains completely invariant and identical throughout lifetime.
(C) Handwriting can only be validly compared if the writer uses the exact same type of pen.
(D) Left-handed writers cannot be forensically compared against right-handed writers at all.

76. Which of the following represents the correct sequence of examination when a document suspected of containing obliterated writing is received at a forensic laboratory?
(A) Destructive chemical testing → VSC examination → Visual observation → Photography
(B) VSC examination → Destructive chemical testing → Photography → Visual observation
(C) Visual observation → Photography → VSC/ Non-destructive testing → Destructive chemical testing (only if necessary and permitted)
(D) Photography → Destructive chemical testing → Visual observation → VSC examination

77. Consider the following statements regarding the decipherment of chemical erasures:
I. Chemical bleaching agents often contain chlorine or oxidizing agents.
II. Treated paper areas may show discoloration or a yellowish stain over time.
III. Fuming the document with iodine vapor can never reveal chemically erased areas.
Which of the above statements is/are correct?
(A) I and II
(B) II and III
(C) I and III
(D) I, II, and III

78. Which lighting technique is most critical for revealing the disturbed surface fibers of a paper where a mechanical erasure has occurred?
(A) Direct transmitted light
(B) Standard coaxial light
(C) Oblique lighting
(D) Infrared luminescence light

79. Lugol's iodine solution is occasionally utilized in the forensic examination of documents primarily to detect:
(A) Polyvinyl alcohol polymer binders
(B) Starch sizing or starch-based inks
(C) Metallic iron residues in writing ink
(D) Fused polymer toners from laser printers

NODIA

80. Under legal provisions defining document offenses, producing a false document with the intent to support a legal claim or title constitutes:
(A) Extortion
(B) Criminal breach of trust
(C) Defamation
(D) Forgery

81. When analyzing an anonymous letter, what is the best non-destructive method for a document examiner to check for indented writing before resorting to chemical methods?
(A) Applying the ESDA technique
(B) Coating the paper substrate with iodine fumes
(C) Swabbing the paper surface directly with methanol
(D) Performing a comprehensive TLC analysis of the ink

82. In historical documents, the highly acidic nature of iron gall ink often leads to a specific form of degradation known as:
(A) Polymerization of organic binders
(B) Oxidative demethylation of dyes
(C) Ink corrosion or ink burn
(D) Photochemical light bleaching

83. If a criminal uses a dilute solution of phenolphthalein as a secret ink, what chemical should the forensic examiner apply to make the writing visible?
(A) A dilute alkali solution

31. In Thin Layer Chromatography (TLC) of writing inks, the silica gel plate acts as the:
(A) Mobile phase
(B) Stationary phase
(C) Developing solvent
(D) Extraction medium

32. During a Thin Layer Chromatography (TLC) examination of a questioned ink, the solvent front travels 10 cm from the origin line. One of the dye components travels 6 cm from the origin line. What is the Retention factor (Rf) value of this dye component?
(A) 0.4
(B) 0.6
(C) 1.6
(D) 16

33. Match the ink formulation in List I with its characteristic component or property in List II:
List I: (Ink Formulation)
P. Iron gall ink
Q. Ballpoint pen ink
R. Gel pen ink
S. Invisible/Secret ink
List II: (Characteristic Component or Property)
1. Polyethylene glycol/resins and synthetic dyes
2. Pigments suspended in a water-based biopolymer gel
3. Ferrous sulfate and tannic/gallic acid
4. Cobalt chloride (develops color on heating)
(A) P-3, Q-1, R-2, S-4
(B) P-1, Q-3, R-2, S-4
(C) P-3, Q-2, R-1, S-4
(D) P-2, Q-1, R-4, S-3

34. Among the following ink examination techniques, which one is destructive to the document substrate?
(A) Visual examination under oblique light
(B) Video Spectral Comparator (VSC) examination
(C) Thin Layer Chromatography (TLC)
(D) Infrared luminescence photography

35. Which advanced spectroscopic technique provides a non-destructive method for identifying the specific chemical composition and molecular "fingerprint" of ink directly on the paper?
(A) Micro-Raman Spectroscopy
(B) Gas Chromatography-Mass Spectrometry (GC-MS)
(C) Capillary Electrophoresis
(D) Inductively Coupled Plasma Mass Spectrometry (ICP-MS)

36. What is a significant advantage of using High-Performance Liquid Chromatography (HPLC) over Thin Layer Chromatography (TLC) for forensic ink analysis?
(A) HPLC analysis does not require physical extraction of ink samples from paper substrates.
(B) HPLC instrumentation is significantly cheaper and more portable for crime scene application.
(C) HPLC methodology relies exclusively on direct visible light observation and detection.
(D) HPLC offers superior quantitative analysis and resolution of dye mixtures.

37. Chemical methods for dating modern ballpoint pen inks often rely on detecting the gradual degradation of specific dyes over time due to light and oxidation. Which common dye is frequently monitored for its sequential demethylation during the aging process?
(A) Indigo carmine dye
(B) Methyl violet
(C) Eosin Y pigment
(D) Tartrazine dye

38. Which of the following represents the correct sequential procedure for performing Thin Layer Chromatography (TLC) on an ink sample in a forensic laboratory?
(A) Spotting the extract on the plate → Extracting ink using a solvent → Placing the plate in a developing chamber → Visualizing the separated bands.
(B) Extracting ink using a solvent → Placing the plate in a developing chamber → Spotting the extract on the plate → Visualizing the separated bands.
(C) Extracting ink using a solvent → Spotting the extract on the plate → Placing the plate in a developing chamber → Visualizing the separated bands.
(D) Placing the plate in a developing chamber → Extracting ink using a solvent → Visualizing the separated bands → Spotting the extract on the plate.

39. Which of the following solvents is highly effective and most commonly used for extracting ballpoint pen ink from paper prior to Thin Layer Chromatography (TLC) analysis?

Downloaded from www.pdf.tube

ANSWERS

1. (A) Making a false document or electronic record to cause damage or injury to any person
Forgery in criminal law is defined as the creation, altering, or making of a false document or electronic record with the specific intent to cause damage or injury to the public or any individual. This deceptive act aims to support a false claim, execute fraud, or induce a person to part with valuable property.

2. (C) Transmitted light forgery
Transmitted light forgery occurs when a genuine signature is illuminated from underneath using a light source, such as a light box or window. The fraudulent document is placed directly over the genuine signature, allowing the perpetrator to trace the visible outline of the signature onto the overlaying paper sheet with high structural accuracy.

3. (A) Ultraviolet (UV) fluorescence examination
Ultraviolet fluorescence examination is a fast, effective, non-destructive method used to identify chemical erasures on documents. Sizing agents and chemical bleaches alter the localized optical fluorescence of paper under ultraviolet light, causing the altered or erased area to display distinct luminescence contrasts compared to the surrounding undisturbed paper fibers without altering physical integrity.

4. (B) I and III are correct
Mechanical erasures physically remove ink or pencil markings from paper surfaces using abrasive tools like rubber erasers or razor blades, which physically damage paper fibers. Conversely, chemical erasures react chemically with ink constituents to alter their chemical structure and render them colorless, preserving the physical fiber structure while effectively bleaching written text.

5. (B) Disruption and lifting of the paper fibers
Executing a mechanical erasure with a sharp blade or abrasive tool physically abrades the outer protective layer of the paper surface. Under a stereomicroscope, this physical abrasion appears as disrupted, abraded, and lifted paper fibers, causing the altered zone to appear rougher, thinner, and less smooth than the surrounding unmanipulated areas.

6. (C) Masking original writing by smearing or stamping over it
Obliteration in document examination refers to the intentional covering or obscuring of original writing using another substance, such as heavy ink, markers, correction fluid, or rubber stamps. This physical masking renders the underlying writing unreadable to the naked eye while keeping the original ink chemically and physically intact underneath the obliterating layer.

NODIA

7. (D) Infrared (IR) luminescence photography
Infrared luminescence photography is highly effective for deciphering obliterated writings when the overlying ink and underlying ink possess different chemical formulations. Under infrared radiation, the top obscuring layer may become transparent while the original ink fluoresces or absorbs infrared light, revealing the hidden underlying text clearly without damaging the physical document substrate.

8. (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
Infrared luminescence distinguishes original inks from obliterating inks because different ink formulations react uniquely to infrared light based on their chemical composition and dye structures. When exposed to infrared radiation, one ink may emit luminescent light while another remains opaque, directly allowing examiners to decipher obscured writing when spectral properties differ.

9. (B) Interlineation
Interlineation denotes the insertion of words, phrases, or entire sentences between existing lines of a previously completed written document. Forensic document examiners investigate interlineations to determine if fraudulent modifications or additions were introduced after original execution, analyzing line spacing, alignment, ink composition, writing pressure, and individual handwriting characteristics during forensic document examinations.

86. (C) Strokes occurred while the first ink was wet, causing bleeding and mixing.
Determining the sequence of intersecting ink strokes relies on physical boundary evidence between separate ink layers. If a second stroke is applied while the first ink remains wet, fluid diffusion, capillary action, and chemical mixing occur at the intersection point, obscuring clear stroke boundaries and preventing reliable sequence determination analysis.

87. (D) Page 3 was un-stapled and re-stapled more often, suggesting tampering or substitution.
Multi-page documents bound together during creation retain matching staple hole alignments across all sheets. If a specific page exhibits multiple sets of staple punctures while surrounding pages show only one set, it provides clear physical evidence that the page was removed, manipulated, or substituted after initial document assembly and stapling.

88. (A) Ink skipping, gooping at direction changes, and stroke striations
Ballpoint pens transfer high-viscosity paste ink via a rotating metal ball. Microscopic examination of ballpoint handwriting reveals characteristic physical features, including ink gooping at sharp directional changes, fine striations caused by minute imperfections on the rotating ball surface, and periodic ink skipping resulting from temporary ball rotation failure during writing.

89. (B) Distance traveled by solute spot / Distance traveled by solvent front
In Thin Layer Chromatography, the Retention factor is calculated by dividing the distance traveled by a separated solute component spot from the origin line by the total distance traveled by the advancing solvent front. Retention factor values range from zero to one, serving as a standardized parameter for comparative chemical identification.

90. (B) The principle of individuality
The foundational principle underlying questioned document examination and handwriting analysis is the principle of individuality, often summarized as Locard's concept that nature never repeats itself exactly. Applied to handwriting, it dictates that no two individuals possess identical writing habits when evaluated across comprehensive combinations of class and individual writing characteristics.

www.nodia.in

Click Here to Buy book on Flipkart

19. (A) Freezing them until they can be properly freeze-dried
When documents recovered from water cannot be processed immediately, freezing them at low temperatures is the established preservation method. Freezing halts biological degradation, microbial mold growth, and chemical bleeding of water-soluble inks. The frozen items remain fully stabilized until controlled laboratory freeze-drying procedures can safely sublimate ice into water vapor without damaging paper fibers.

20. (B) II only
Oblique lighting is an essential technique for examining charred documents, making statement II incorrect. Side lighting highlights surface relief, indentations, and residual paper reflectivity, allowing examiners to decipher embossed strokes or text patterns. While charred documents become dark, brittle, and subject to shrinkage, side lighting effectively enhances contrast to reveal fine physical details.

21. (B) The continuous ballpoint furrow passes uninterrupted across the fountain pen line.
When determining line sequence, ballpoint pens create a physical mechanical furrow or indentation in paper fibers due to heavy tip pressure. If a ballpoint stroke is executed after a liquid fountain pen line, microscopic examination reveals that the physical furrow continues smoothly and uninterrupted across the pre-existing fluid ink stroke, proving its chronological sequence.

22. (C) Paper fibers crack at the fold, disrupting ink and causing particles to flake off.
Folding paper causes intense localized mechanical stress along the crease. If writing existed prior to folding, the bending causes paper fibers to fracture, which ruptures dried ink film, causes ink particles to flake off, and creates visible microscopic breaks along the ink line. Conversely, writing over an existing fold leads to ink bleeding.

23. (D) Absolute age is the creation date; relative age establishes the sequence of entries.
In document analysis, absolute age refers to determining the specific calendar date, year, or time frame in which a document or ink stroke was produced. Relative age determines chronological order or sequence, establishing whether a particular signature, stroke, page, or text insertion was written before or after another entry on the document substrate.

24. (A) Oxidation of ferrous to ferric compounds, darkening the ink to a permanent black/brown color.
Iron gallotannate ink initially applies as a pale bluish-grey fluid containing soluble ferrous sulfate and tannic acid. Upon exposure to atmospheric oxygen, soluble ferrous iron oxidizes into insoluble ferric iron compounds, producing an intense, water-resistant dark brown or black ferric gallotannate complex that binds permanently within paper cellulose fibers over time.

25. (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
Solvent extraction rates are used to estimate relative ink age because ballpoint pen inks contain volatile solvents, resins, and polymer binders. As ink ages on paper, volatile solvents evaporate and resinous components undergo progressive polymerization, causing the ink matrix to harden, which progressively decreases its rate of chemical extraction into organic solvents over time.

26. (B) Dyes are dissolved in the liquid vehicle, while pigments are suspended solid particles.
Dyes are soluble organic chemical colorants that completely dissolve in a liquid solvent vehicle, forming a homogenous liquid that absorbs into paper fibers. In contrast, pigments are finely ground, insoluble solid colorant particles suspended within a vehicle, which typically sit on top of the paper surface rather than fully dissolving into liquid.

27. (A) A water-based gel thickened with biopolymers
Gel pen ink formulations utilize a liquid vehicle consisting primarily of a water-based gel thickened with biopolymers or synthetic gums like xanthan gum. This thixotropic formulation maintains high viscosity at rest inside the pen cartridge, but thins under shear stress at the rolling ball tip, delivering insoluble pigment particles smoothly onto paper.

28. (C) Printing ink
Printing inks engineered for offset lithography or letterpress applications possess high viscosity and tackiness, utilizing thick vehicles formulated

Downloaded from www.pdf.tube

with linseed oil, mineral oils, synthetic varnishes, and resins. These paste-like inks are transferred to substrates under heavy mechanical printing pressure, forming sharp, durable impressions without unwanted bleeding or spreading across paper fibers.

29. (D) The exact chemical molecular weight of the ink dyes
The Video Spectral Comparator is an optical non-destructive analytical instrument designed to evaluate documents across ultraviolet, visible, and infrared wavebands. While it excels at analyzing optical fluorescence, infrared absorption, luminescence, and surface features under various illumination angles, it cannot measure chemical molecular weights, which requires destructive analytical separation like mass spectrometry.

30. (B) II and III
The Video Spectral Comparator is a non-destructive optical system that enables real-time visualization of ink behavior across diverse illumination wavelengths, making statement I false. Statements II and III are correct: it reveals spectral differences between inks and allows examiners to decipher obliterated entries when covering inks transmit infrared light while original underlying inks absorb it.

31. (B) Stationary phase
In Thin Layer Chromatography for ink analysis, a flat plate coated with a uniform layer of adsorbent silica gel serves as the stationary phase. The silica gel holds the sample mixture while the liquid mobile phase solvent ascends through capillary action, separating individual dye components based on their relative chemical affinities and differential partitioning behaviors.

32. (B) 0.6
The Retention factor in chromatography is calculated by dividing the distance traveled by the compound spot by the total distance traveled by the solvent front. Dividing 6 cm by 10 cm yields a value of 0.6. Retention factor values range between zero and one, providing a standardized metric for identifying dye components.

33. (A) P-3, Q-1, R-2, S-4
Iron gall ink consists of ferrous sulfate and gallic acid. Ballpoint ink contains synthetic dyes dissolved in glycol resins. Gel pen ink comprises insoluble pigment particles suspended in a water-based biopolymer matrix. Invisible ink formulations containing cobalt chloride turn from pale blue to visible magenta or pink upon exposure to heat during forensic development.

34. (C) Thin Layer Chromatography (TLC)
Thin Layer Chromatography is classified as a destructive testing methodology because it requires removing micro-plugs of paper containing ink using a punch needle. While visual inspection, Video Spectral Comparator analysis, and infrared luminescence photography rely on non-destructive optical radiation, TLC physically damages the paper substrate by extracting physical samples for chemical solvent separation.

35. (A) Micro-Raman Spectroscopy
Micro-Raman Spectroscopy provides a non-destructive analytical method for determining the chemical composition and molecular structure of ink directly on paper. By measuring the inelastic scattering of monochromatic laser light, it yields detailed vibrational spectrum fingerprints of dyes and pigments without removing paper fibers or subjecting the document to solvent extraction or destruction.

36. (D) HPLC offers superior quantitative analysis and resolution of dye mixtures.
High-Performance Liquid Chromatography offers superior resolution, sensitivity, and precise quantitative analytical measurement of complex dye mixtures compared to Thin Layer Chromatography. Utilizing high-pressure liquid pumps and sensitive optical detectors, HPLC separates, quantifies, and isolates trace ink components with extreme precision, providing detailed chromatographic profiles for accurate comparative forensic ink analysis.

37. (B) Methyl violet
Methyl violet is a widely used triarylmethane dye in blue and black ballpoint inks. Over time, exposure to ambient light and oxygen induces progressive photochemical demethylation, sequentially stripping methyl groups to form tetramethyl, trimethyl, and dimethyl derivatives. Monitoring these specific breakdown products allows forensic scientists to evaluate relative ink age on documents.

NODIA

38. (C) Extracting ink using a solvent → Spotting the extract on the plate → Placing the plate in a developing chamber → Visualizing the separated bands.
Performing Thin Layer Chromatography on ink involves a standard sequential process. First, ink micro-samples punched from paper are dissolved in a solvent to extract dye molecules. Next, the concentrated solution is spotted onto a silica gel plate. The plate is then developed in a sealed solvent chamber, and finally, separated color bands are visualized under white or UV light.

39. (D) Pyridine or Methanol
Ballpoint pen inks contain synthetic dyes dissolved in viscous resins and high-boiling glycol solvents. Extracting these non-water-soluble dyes from paper substrates requires polar organic solvents. Pyridine and methanol are highly efficient extracting agents, effectively dissolving dried resins and dyes without dissolving paper cellulose fibers prior to Thin Layer Chromatography separation.

40. (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
Ink manufacturers voluntarily incorporate chemical ink tags, such as trace rare-earth element compounds or specific fluorophores, into ink formulations. These secret chemical markers are updated annually by manufacturers, providing an accurate chronological reference that allows forensic examiners to identify the exact year of production by analyzing ink tags present in a sample.

41. (B) Mechanical groundwood pulping
Mechanical groundwood pulping mechanically grinds wood logs to yield paper pulp without removing natural lignin binders. Because lignin remains intact within the pulp fibers, paper produced through this process—such as newsprint—rapidly undergoes photochemical degradation and oxidation, causing noticeable yellowing, embrittlement, and structural deterioration upon exposure to light and atmospheric air.

42. (B) To reduce liquid penetration and prevent ink feathering or bleeding
Sizing agents like rosin, alum, or synthetic compounds are added to paper pulp or applied to paper surfaces to alter water absorbency. By reducing fluid penetration and capillarity, sizing prevents liquid inks from spreading, feathering, or bleeding through porous cellulose fibers, ensuring sharp, well-defined printed or written characters during document creation.

43. (A) Rosin precipitated with alum
Historically, rosin precipitated with papermaker's alum (aluminum sulfate) served as the primary internal sizing agent in machine-made paper. Introduced in the early nineteenth century, this acidic sizing system rendered paper water-resistant, though the acidic residue accelerates long-term cellulose hydrolytic degradation, causing paper sheets to turn yellow and become extremely brittle over time.

44. (C) Kaolin (China clay)
Kaolin, commonly known as China clay, is a hydrous aluminum silicate mineral widely used as a paper filler. Mixed into paper pulp, kaolin fills void spaces between cellulose fibers, significantly improving paper opacity, surface smoothness, brightness, and ink receptivity, while decreasing production costs without degrading the structural integrity of the paper matrix.

45. (B) I, III, and IV
Cellulose fibers form the essential structural matrix of paper. Internal sizing is incorporated directly into wet pulp prior to sheet formation to control water absorbency. Optical Brightening Agents absorb ultraviolet radiation and re-emit visible blue light, producing bright fluorescence. Statement II is incorrect because titanium dioxide is added to increase, not decrease, brightness.

46. (C) The Dandy roll
A true watermark is produced during paper manufacturing using a specialized wire-mesh cylinder termed a Dandy roll. As wet pulp moves along the Fourdrinier wire, the raised wire design on the Dandy roll presses against the soft sheet, locally displacing paper fibers and creating precise variations in sheet density and light transmission.

47. (B) It sits on the surface without causing true fiber displacement.
Artificial or simulated watermarks are produced after paper manufacturing by printing designs onto finished sheets using transparent inks, oils, or resins to simulate translucency. Unlike true watermarks created during wet sheet formation,

Click Here to Buy book on Amazon

simulated watermarks sit entirely on the paper surface without causing physical displacement, reorientation, or localized density variations of underlying cellulose fibers.

48. (D) Precision micrometer gauge
A precision micrometer gauge or paper thickness gauge is the standard instrument used by forensic document examiners to measure paper thickness. Measured in micrometers or fractions of an inch, precise thickness measurements assist examiners in comparing document sheets, detecting page substitution, and identifying structural variations between paper batches or manufacturing sources.

49. (A) Its ability to transmit light through its thickness
Opacity refers to the optical property of a paper sheet that measures its capacity to obstruct or transmit light through its total thickness. High opacity prevents text printed on one side from showing through to the reverse side, determined directly by fiber arrangement, pulping process, internal sizing, and inorganic filler content like kaolin or titanium dioxide.

50. (A) III, I, II, IV
Paper manufacturing follows a strict chronological industrial sequence. First, raw timber is chipped and chemically or mechanically pulped (III). Next, the resulting pulp is subjected to beating and chemical refining (I). The refined pulp slurry is then formed into continuous sheets on a Fourdrinier wire mesh (II), before undergoing final drying and calendering rollers (IV).

51. (A) Rag fibers
Herzberg stain, composed of zinc chloride, iodine, and potassium iodide, is a standard chemical reagent used in microscopic paper fiber analysis. When applied to paper fibers, Herzberg stain produces a characteristic wine-red or pinkish-purple color reaction specifically on pure rag fibers (cotton or linen), easily distinguishing them from wood pulp fibers.

52. (A) P-3, Q-4, R-1, S-2
Herzberg stain is a general fiber identification reagent containing zinc chloro-iodide. Phloroglucinol stain reacts with high-lignin mechanical wood pulps to turn magenta-red. Iodine solution interacts with starch sizing agents to yield a deep blue color. Ultraviolet illumination detects optical brightening agents, which fluoresce brightly under short or long UV wavebands.

53. (B) Optical Brightening Agents (OBAs)
Bright fluorescence under ultraviolet light indicates the presence of Optical Brightening Agents or fluorescent whitening agents added during paper manufacturing. These synthetic chemical additives absorb invisible ultraviolet light radiation and re-emit light in the blue visible spectrum, enhancing perceived sheet whiteness and brightness when inspected under UV sources in forensic laboratories.

54. (C) The horizontal spacing, measured in characters per inch (cpi)
Escapement pitch in typewriter mechanics defines the uniform horizontal distance the typewriter carriage advances after each keystroke, expressed as characters per inch. Standard monospaced mechanical typewriters feature fixed escapement pitches, such as Pica, which measures 10 characters per inch, or Elite, which measures 12 characters per inch across typed document lines.

55. (D) Elite
Typewriter typefaces are classified by horizontal escapement pitch. A typeface that fits exactly 12 characters per horizontal inch is defined as Elite type. In contrast, Pica typeface fits 10 characters per inch. Determining escapement pitch is an essential preliminary class characteristic evaluation conducted when analyzing questioned typewritten document text samples in forensics.

56. (A) Whether a cloth ribbon or a carbon film ribbon was used
Microscopic evaluation of typed character edges reveals distinct ribbon characteristics. Woven fabric ribbons impart noticeable textile thread weave patterns along letter margins and deposit ink irregularly into paper fibers. Conversely, single-use carbon film ribbons yield extremely crisp, sharp character outlines without any woven thread impressions, allowing document examiners to distinguish ribbon types.

57. (B) Typeface defects in a specific typewriter
A transparent glass alignment grid plate is placed directly over typewritten text to measure precise horizontal and vertical character positions. Typebars often develop individual mechanical defects over time, causing

NODIA

character misalignments, vertical tilts, or lateral displacement relative to standard grid lines, enabling document examiners to identify alignment defects unique to a specific typewriter.

58. (A) I and II
Statements I and II correctly describe mechanical typewriter defects: horizontal misalignment occurs when characters print laterally off-center, while "off-its-feet" defects occur when a bent typebar strikes unevenly, depositing heavier ink on one side of the letter impression. Statement III is incorrect because rebound involves a typebar bouncing to produce a faint secondary image.

59. (A) Rebound
Rebound in mechanical typewriting occurs when a typebar strikes the rubber platen, rapidly bounces back due to worn escapement springs or improper key release, and strikes the paper a second time. This mechanical defect leaves a faint, secondary shadow impression slightly offset from the primary typed character, serving as an individualizing characteristic.

60. (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
Single-use carbon film typewriter ribbons are highly valuable forensic evidence because each mechanical keystroke physically lifts ink from the polyethylene film ribbon. This action leaves a clear, legible, continuous negative text impression across the ribbon length, allowing investigators to directly read the complete text sequence typed on the machine during ribbon usage.

61. (D) Polymer toner fused onto paper, appearing slightly raised and glossy
Laser printers utilize electrophotographic technology where dry polymer toner powder is attracted to a charged drum and transferred onto paper. The document then passes through heated fuser rollers, melting polymer resin particles directly onto paper surfaces. Under microscopic magnification, this creates character strokes with fused, slightly raised, glossy surfaces and crisp outline boundaries.

62. (C) Inkjet printer
Inkjet printing functions by expelling liquid ink droplets through microscopic nozzles onto paper substrates. Under stereomicroscopic magnification, liquid ink exhibits characteristic wicking or feathering along cellulose paper fibers, accompanied by tiny satellite ink droplets dispersed around printed character edges due to liquid overspray during dynamic jet expulsion from moving print heads.

63. (B) Striking a pin matrix head against an inked ribbon onto paper
Dot matrix printing is an impact printing technology where mechanical pins in a print head strike an inked ribbon against paper. Arranged in vertical matrix grids (such as 9 or 24 pins), individual pin impacts form characters composed of distinct dot patterns, leaving micro-indentations and characteristic ribbon fiber impressions on paper.

64. (D) Help identify the copier through platen or optical system defects
Trash marks on photocopies are unwanted specs, dots, or marks transferred onto copies. They originate from physical defects, dust particles, scratches, or correction fluid residues present on the glass platen, cover, or optical lenses of a photocopier, providing unique class and individual characteristics that assist examiners in identifying specific machines.

65. (A) To encode Machine Identification Codes (MIC) for anti-counterfeiting tracking
Modern color laser printers and copiers encode invisible Machine Identification Codes on printed pages using tiny yellow tracking dots. Arranged in repeating steganographic grid patterns, these microscopic dots encode device serial numbers, timestamps, and model identifiers, enabling law enforcement agencies to trace counterfeit banknotes or illicit documents back to specific machines.

66. (A) P-2, Q-1, R-4, S-3
Inkjet printers generate micro-splattered droplets and fiber wicking. Color laser printers produce fused polymer toner particles accompanied by Machine Identification yellow tracking dots. Mechanical typewriters produce physical impact indentations and ribbon fabric impressions. Photocopiers display characteristic trash marks resulting from dust, scratches, or debris on platen glass optical exposure surfaces.

Downloaded from www.pdf.tube

67. (A) The signature will be composed of a matrix of discrete halftone or dithered dots.
Digitized and printed signatures exhibit distinct microscopic structure compared to authentic fluid ink handwriting. Scanners and digital printers reconstruct image detail using dithered grid patterns or CMYK halftone dots. Microscopic inspection reveals these discrete dots, along with an absence of continuous pen strokes, ballpoint furrows, and ink paper fiber penetration.

68. (D) The photocopy lacks 3D ink deposits and physical paper indentations.
Original handwritten or typed documents possess three-dimensional physical characteristics, including writing pressure furrows, embossed impressions, paper fiber indentations, and raised ink layers. In contrast, high-quality color photocopies create flat two-dimensional optical images, completely lacking depth features, pen pressure indentations, and physical ink deposits that typically characterize genuine original written documents.

69. (C) I, II, and IV
Laser toner sits on paper fibers as fused polymer film, while liquid inkjet ink absorbs into fibers, making statement I correct. Magnetic components exist in black laser toners, satisfying statement II. Inkjet lines exhibit fuzzy edges due to liquid wicking, confirming statement IV. Statement III is incorrect as inkjet printing does not use fuser heat and pressure.

70. (C) Intaglio (raised) printing
Intaglio printing is a anti-counterfeiting security feature used on genuine currency notes. It involves transferring high-viscosity ink under immense mechanical pressure from engraved steel plates, producing distinctive, tactile, three-dimensional raised ink relief patterns on paper. Commercial non-impact inkjet printers cannot reproduce this raised tactile physical profile on banknote paper substrates.

71. (D) Photopolymer curing
Modern custom rubber stamps are manufactured primarily using two production methods: traditional heat vulcanization of natural or synthetic rubber inside engraved matrix molds, and photopolymer resin light curing. In photopolymer processing, liquid ultraviolet-sensitive polymer resins are exposed to targeted ultraviolet radiation through negative photographic films, curing precise raised printing dies.

NODIA

72. (A) Wear, dirt, and specific cuts in the rubber die
Identifying a specific rubber stamp that produced a questioned impression relies on individual characteristics. While font design and stamp shape represent broad class characteristics, unique physical defects—such as surface wear, localized rubber degradation, micro-cuts, chipped die edges, and persistent trapped dirt particles—create distinct individual marks transferred onto paper document substrates.

73. (B) The ballpoint pen furrow cuts through the stamp ink layer.
Determining the sequence between intersecting ballpoint pen strokes and stamp impressions requires microscopic examination. When handwriting is executed after a stamp impression, the mechanical tip of the ballpoint pen presses into paper fibers, creating a physical furrow that visibly cuts through and indents the pre-existing dried layer of rubber stamp ink.

74. (B) Irregular fracturing, remelting, or matrix design mismatching
Wax seals on confidential documents or envelopes are examined for indicators of unauthorized opening or forgery. Thermal tampering disrupts physical seal structures, resulting in microscopic re-melting marks, stress fracturing, air bubbles, altered gloss, or structural mismatches when replaced seals fail to align perfectly with original matrix dimensions and surrounding paper fibers.

75. (A) No two individuals write identically, and writing has natural variation.
Forensic handwriting comparison rests on two fundamental principles: no two individuals share identical handwriting characteristics when evaluated comprehensively across sufficient writing samples, and no single writer executes handwriting identically on every occasion, exhibiting natural variations across repeated writing instances while maintaining unique, subconscious individual writing habits over long time frames.

76. (C) Visual observation → Photography → VSC/ Non-destructive testing → Destructive chemical testing (only if necessary and permitted)
Forensic document examinations adhere to a strict analytical hierarchy. First, documents undergo macro and microscopic visual observation under white light. Next, high-resolution photography documents physical condition. Non-destructive optical methods like Video Spectral Comparator examination are performed next, ensuring destructive chemical sampling is used only as a last resort when legally permitted.

77. (A) I and II
Chemical erasures involve applying oxidizing bleaching agents like chlorine or hypochlorites to decompose ink dyes into colorless forms, making statement I correct. Treated areas frequently exhibit yellowish paper stains or fiber degradation over time, satisfying statement II. Statement III is incorrect because iodine vapor reacts with starch or altered fibers, revealing erased zones.

78. (C) Oblique lighting
Oblique lighting, where light is directed across a paper surface at a low angle, is the most effective illumination method for detecting mechanical erasures. Low-angle lighting casts prominent shadow patterns across abraded, disrupted, and lifted paper fibers, sharply accentuating altered texture variations and surface indentations that remain invisible under direct lighting.

79. (B) Starch sizing or starch-based inks
Lugol's iodine solution contains iodine and potassium iodide dissolved in water, serving as a classical chemical reagent that selectively reacts with amylose structures in starch. When applied to questioned documents, it forms a characteristic deep blue or purple chemical complex, enabling examiners to detect starch-based paper sizing variations, altered regions, or starch inks.

80. (D) Forgery
Under statutory criminal provisions, forgery is legally established when a person fabricates, alters, or executes a false document or electronic record with specific intent to deceive, support a legal claim, establish title, cause financial injury, or induce another individual to enter into a contract or part with valuable personal property.

81. (A) Applying the ESDA technique
The Electrostatic Detection Apparatus provides a non-destructive method for visualizing indented writing impressions on paper without chemical reagents. By utilizing electrostatic charges and toner application, ESDA recovers paper fiber compressions located several pages beneath writing without altering, staining, or physically destroying original document evidence during detailed forensic document case examinations.

82. (C) Ink corrosion or ink burn
Historical iron gall inks contain free sulfuric acid produced during synthesis from ferrous sulfate and gallic acid. Over time, this concentrated acidic residual content, combined with transition metal ions, catalyzes acid hydrolysis and oxidative degradation of cellulose, resulting in ink corrosion or ink burn that eats holes directly through paper.

83. (A) A dilute alkali solution
Phenolphthalein is a chemical pH indicator that remains colorless in acidic or neutral environments (pH below 8.2). When treated with a dilute alkali solution such as sodium hydroxide or ammonium hydroxide, phenolphthalein undergoes structural rearrangement into its anionic form, turning a vibrant magenta-pink color that visually reveals secret writing entries.

84. (D) Erasing chemicals destroy or alter optical brightening agents (OBAs) in that area.
Paper manufacturers add Optical Brightening Agents to enhance paper whiteness, causing sheets to fluoresce brightly under ultraviolet illumination. When chemical erasers containing bleaches or solvents are applied, they decompose OBAs in that specific zone. Consequently, the erased area fails to fluoresce, appearing as a non-fluorescent dark patch against the surrounding bright paper.

85. (B) ESDA is more sensitive, detecting indentations several pages beneath writing.
Electrostatic Detection Apparatus significantly surpasses oblique lighting in sensitivity for visualizing indented writing. While side lighting reveals shallow indentations on top sheets using shadows, ESDA detects microscopic electrostatic variations caused by paper fiber compression, successfully recovering highly faint impressions located up to seven or more sheets beneath original writing strokes.

Click Here to Buy book on Flipkart

10. (B) Discrepancies in paper thickness, watermark, or staple holes on one page
Page substitution in multi-page documents is conclusively identified by evaluating physical and chemical inconsistencies across individual sheets. Discrepancies in paper thickness, unique watermarks, paper fiber composition, optical brightener response, dimensions, alignment of prior staple holes, or variations in print technology provide strong physical evidence that a specific sheet originated from a different batch or source.

11. (A) Paper fiber depressions caused by writing pressure on an overlying sheet
Indented writings, also termed second-page impressions, are physical depressions created on underlying sheets of paper when pressure is applied while writing on an overlying document. The mechanical force of the writing instrument compresses the cellulose paper fibers beneath, leaving invisible or subtle dimensional impressions that can be deciphered using specialized physical or electrostatic techniques.

12. (C) It uses corona discharge to create an electrostatic image attracting toner to paper stress areas.
The Electrostatic Detection Apparatus operates by applying a high-voltage corona discharge to charge a thin polymer Mylar film placed over a document. Variations in paper surface topography and physical fiber compression caused by writing pressure create localized potential differences, attracting black toner powder preferentially to these indented regions to form a clear visual representation.

13. (A) P-3, Q-1, R-2, S-4
Secret writing inks require specific reagents or physical conditions to become visible. Organic substances like lemon juice char and darken upon heating. Starch solutions react with iodine vapor to produce a distinct blue-black complex. Phenolphthalein turns bright pink when treated with alkali solutions. Ferrous sulfate forms a dark chemical precipitate when exposed to potassium ferricyanide.

14. (C) Placing them in a rigid padded container to prevent movement
Charred documents are extremely fragile, brittle, and susceptible to severe disintegration from minor physical vibrations or air currents. To preserve their structural integrity, they must be carefully placed on cotton padding or soft cushioning inside rigid containers, ensuring they remain immovably secured during transit to the forensic examination facility without risk of fragmentation.

15. (B) A dilute polyvinyl acetate or water-glycerine-alcohol solution
Extremely dry and brittle charred documents require chemical stabilization before physical handling or flattening can occur. Spraying a fine mist of dilute polyvinyl acetate or a water-glycerine-alcohol solution increases fiber flexibility and moisture content, preventing total crumbling while enabling examiners to carefully unroll, flatten, and document written details on delicate charred substrates.

16. (A) II, III, IV, I
Developing indented writing using ESDA follows a precise sequence. First, the document is humidified to adjust internal moisture levels for optimal conductivity. Next, a thin protective Mylar polymer film is laid over the sheet. An electrostatic charge is then imparted using a corona wand, and finally, cascade developer toner is applied to visualize impressions.

17. (A) Individual characteristic match
Achieving a physical match or jigsaw fit between torn document fragments provides conclusive proof of common origin. The unique, random fracture patterns, torn paper fibers, and matching surface irregularities create individual characteristics that uniquely link two or more separated pieces to the exact same original sheet, excluding all other potential sources.

18. (C) Ultraviolet (UV) and Infrared (IR) imaging
Faded inks on aged or historical documents can be effectively restored and deciphered using non-destructive spectral techniques, specifically ultraviolet and infrared imaging. Variations in absorption, reflection, and luminescence properties under non-visible light spectrums enhance contrast between degraded ink remnants and paper backgrounds, rendering illegible historical writing clearly readable without physical sample alteration.

NODIA

CHAPTER 26

Counterfeit Currency Detection

NODIA

1. Which section of the Indian Penal Code (IPC) specifically deals with using as genuine, forged or counterfeit currency-notes or bank-notes?
(A) Section 489A
(B) Section 489B
(C) Section 489C
(D) Section 489D

2. What is the primary base material used in the manufacturing of genuine Indian currency paper?
(A) 100% Wood pulp
(B) A blend of 75% cotton and 25% linen
(C) Polymer-infused balsam wood
(D) 100% Cotton rag

3. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Intaglio printing provides a distinct tactile, raised feel on genuine currency notes.
Reason (R): Intaglio printing uses high pressure to force the paper into ink-filled, recessed grooves on the printing plate.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

4. Match the security features in List I with their characteristic appearance in List II.
List I
P. Optically Variable Ink (OVI)
Q. Latent Image
R. Watermark
S. See-through Register
List II
1. Visible against transmitted light
2. Shifts colour from green to blue when tilted
3. Aligns perfectly on the obverse and reverse when held against light
4. Shows denominational numeral when held horizontally at eye level
(A) P-4, Q-2, R-1, S-3
(B) P-2, Q-4, R-3, S-1
(C) P-2, Q-4, R-1, S-3
(D) P-1, Q-3, R-2, S-4

5. Consider the following statements regarding the security thread in genuine Mahatma Gandhi New Series (MGNS) ₹500 notes:
I. It is a windowed security thread that appears as a continuous line when held against light.
II. It shifts colour from green to blue when the note is tilted.
III. It contains magnetic and machine-readable properties.
Which of the above statements are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

6. Where is the micro-lettering typically located on the Mahatma Gandhi New Series ₹500 bank note?
(A) Exclusively along the outer edge bleed lines on both sides
(B) Centrally positioned within the primary watermark window
(C) Continuously woven along the full length of the security thread
(D) On Mahatma Gandhi's collar and adjacent obverse areas

7. The Mahatma Gandhi New Series (MGNS) of bank notes was primarily introduced in which year?
(A) 1996
(B) 2005
(C) 2016
(D) 2020

8. Which of the following is an INCORRECT characteristic of a typical genuine Indian currency note?
(A) The currency paper substrate does not fluoresce brightly under standard ultraviolet light.
(B) The multi-tonal watermark is created

during manufacturing by varying paper pulp density.
(C) The background tints and geometric patterns are printed using the intaglio process.
(D) The paper contains scattered dual-coloured optical fibres clearly visible under UV light.

9. Arrange the following standard forensic examination steps for a suspected counterfeit currency note in the most logical procedural sequence:
I. Video Spectral Comparator (VSC) examination
II. Naked eye visual and tactile examination
III. Examination under a stereomicroscope
IV. Examination under standard Ultraviolet (UV) light
(A) II, III, IV, I
(B) IV, II, III, I
(C) III, II, I, IV
(D) II, IV, III, I

10. The Optically Variable Ink (OVI) used for the denominational numeral on the ₹500 and ₹2000 MGNS notes changes between which two colours?
(A) Green to Blue
(B) Red to Gold
(C) Purple to Green
(D) Blue to Black

11. Which of the following features on an Indian currency note is NOT printed using the intaglio process?
(A) The portrait of Mahatma Gandhi
(B) The serial numbering panel
(C) The Ashoka Pillar emblem
(D) The bleed lines on the edges

12. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Counterfeit notes produced by colour photocopiers entirely lack the raised, tactile feel of genuine notes.
Reason (R): Photocopiers use a process of heat-fusing toner particles onto the flat surface of the paper, rather than pressing paper into engraved plates.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

13. Consider the following characteristics regarding genuine Indian currency paper:
I. It possesses a characteristic "crisp" sound or rattle.
II. It is UV dull and does not glow brightly under an ultraviolet lamp.
III. It incorporates synthetic fluorescent fibres mixed directly into the pulp.
IV. It uses a high concentration of wood pulp to increase tensile strength.
Which of the above statements are correct?
(A) I, II, and III only
(B) I, II, and IV only
(C) II, III, and IV only
(D) I, III, and IV only

14. In Indian currency, the latent image feature becomes visible only when the note is held in which specific orientation?
(A) Held completely vertically under a standard ultraviolet lamp
(B) Pressed entirely flat against an opaque dark background
(C) Horizontally at eye level and tilted against light
(D) Folded exactly in half along its central vertical line

15. Match the printing techniques in List I with the corresponding currency feature in List II.
List I
P. Letterpress
Q. Offset Lithography
R. Intaglio
S. Simultan Press
List II
1. See-through register
2. Multi-coloured background tints
3. Serial numbers
4. Ashoka Pillar emblem and Bleed lines
(A) P-2, Q-3, R-1, S-4
(B) P-4, Q-1, R-2, S-3
(C) P-3, Q-4, R-1, S-2
(D) P-3, Q-2, R-4, S-1

16. Which central agency in India is specifically mandated to investigate cases involving Fake Indian Currency Notes (FICN) that pose a threat to national security and involve terror funding?
(A) Central Bureau of Investigation (CBI)
(B) Enforcement Directorate (ED)
(C) National Investigation Agency (NIA)
(D) Research and Analysis Wing (RAW)

Downloaded from www.pdf.tube

17. When a genuine MGNS ₹500 note is examined under an Ultraviolet (UV) light source at 365 nm, what is typically observed regarding the serial numbers?
(A) Both number panels disappear entirely.
(B) The serial numbers fluoresce brightly.
(C) The numbers turn completely black.
(D) Only the prefix letters fluoresce while numbers remain dull.

18. Consider the following methods often used by criminals to counterfeit currency:
I. Colour laser photocopying
II. Scanning and inkjet printing
III. Watermark embedding through pulp density variation
Which of the above statements are correct regarding methods used for counterfeiting?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

19. What specific shape or design forms the "See-through Register" on the obverse and reverse of the MGNS ₹2000 bank note?
(A) The numeral 2000
(B) A decorative geometric floral motif pattern
(C) The detailed architectural Ashoka Pillar
(D) The stylized national Swachh Bharat logo

20. How many angular bleed lines are printed in intaglio on the left and right obverse edges of a genuine MGNS ₹500 note to aid the visually impaired?
(A) 4 lines
(B) 5 lines
(C) 6 lines
(D) 7 lines

21. Select the correct historical sequence of the introduction of major Indian currency series from oldest to most recent:
(A) Ashoka Pillar Series → Mahatma Gandhi Series 1996 → Mahatma Gandhi Series 2005 → Mahatma Gandhi New Series
(B) Mahatma Gandhi Series 1996 → Ashoka Pillar Series → Mahatma Gandhi Series 2005 → Mahatma Gandhi New Series
(C) Ashoka Pillar Series → Mahatma Gandhi Series 2005 → Mahatma Gandhi Series 1996 → Mahatma Gandhi New Series
(D) Mahatma Gandhi Series 1996 → Mahatma Gandhi Series 2005 → Ashoka Pillar Series → Mahatma Gandhi New Series

22. With the exception of the ₹1 note, who issues all currency notes in India?
(A) Ministry of Finance, Government of India
(B) State Bank of India
(C) NITI Aayog
(D) Reserve Bank of India

23. Which of the following is an INCORRECT pairing of an MGNS denomination and its reverse motif?
(A) ₹50 - Architectural motif of Hampi with Chariot
(B) ₹500 - Sun Temple, Konark
(C) ₹100 - Stepwell motif of Rani Ki Vav
(D) ₹200 - Buddhist monument of Sanchi Stupa

24. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): The security thread in MGNS notes is partially visible on the obverse as distinct windows but appears continuous against transmitted light.
Reason (R): The thread is interwoven directly into the paper mass during manufacture rather than pasted onto the surface.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

25. Consider the following statements regarding the capabilities of a Video Spectral Comparator (VSC) in counterfeit currency detection:
I. It can examine the currency under various wavelengths of UV, visible, and IR light.
II. It allows for magnification and specific spot-measurement of paper fluorescence.
III. It performs destructive chemical analysis of the ink composition.
IV. It can detect IR-absorbent and IR-transparent inks.
Which of the above statements are correct?
(A) I, II, and III only
(B) I, II, and IV only
(C) II, III, and IV only
(D) I, III, and IV only

NODIA

82. Under microscopic examination, what is the key visual difference between intaglio and letterpress printing on a currency note?
(A) Intaglio exhibits a prominent outer ink squeeze halo effect at character edges, whereas letterpress creates thick ink deposits layered above the substrate.
(B) Both processes exhibit completely identical microscopic dot-matrix pattern distributions across printed characters.
(C) Intaglio creates an entirely flat, non-tactile ink laydown, whereas letterpress produces deep uninked structural indentations along character borders.
(D) Intaglio shows thick ink piled above paper; letterpress shows ink squeeze at character edges.

83. The Latent Image on genuine Indian bank notes shows the denominational numeral. Where is it located relative to the Mahatma Gandhi portrait on the MGNS ₹500 note?
(A) On the vertical band to the right of the portrait
(B) Positioned directly above the main portrait adjacent to the top margin boundary
(C) Positioned directly below the main portrait integrated within the serial number panel
(D) Positioned along the extreme left edge superimposed directly over the bleed line features

84. A forensic document examiner handling foreign currency should know that standard US Dollar paper is distinctively composed of:
(A) 100% high-grade purified Balsam wood pulp
(B) 100% synthetic flexible polymer plastic
(C) Blend of 75% cotton and 25% linen
(D) 50% natural Silk and 50% Cotton fibres

85. Who is the issuing authority for the ₹1 currency note, making it an exception to the RBI's issuance of all other denominations?
(A) Government of India (Finance Ministry)
(B) State Bank of India (Central Office Mumbai)
(C) Reserve Bank of India (Issue Department)
(D) NITI Aayog (National Institution for Transforming India)

86. When examined under specific infrared (IR) light wavelengths, certain printed elements of genuine currency, such as parts of the Mahatma Gandhi portrait, disappear or become transparent. This important security feature is known as:
(A) Covert ultraviolet (UV) light fluorescence
(B) Dynamic optically variable angle shifting
(C) Polarized light birefringence masking
(D) IR drop-out

87. The reverse motif of the MGNS ₹500 bank note depicts which iconic Indian heritage site?
(A) Taj Mahal
(B) Red Fort
(C) Sanchi Stupa
(D) Gateway of India

88. Under Indian criminal law, the mere possession of forged or counterfeit currency-notes or bank-notes, knowing or having reason to believe the same to be forged, and intending to use them as genuine, is a punishable offence. Which section codifies this specific offence?
(A) Section 489A IPC
(B) Section 420 IPC
(C) Section 489C IPC
(D) Section 120B IPC

89. Suspected counterfeit currency notes submitted by police are primarily analysed in which specific section of a Forensic Science Laboratory (FSL)?
(A) Forensic Serology and Biology Division
(B) Digital Forensics and Cybercrime Section
(C) Forensic Toxicology and Chemical Section
(D) Questioned Document Section

90. Which of the following best describes the difference in the application of the watermark between a genuine Indian currency note and a typical counterfeit?
(A) Genuine watermarks stem from paper pulp density variation; counterfeits are printed on the surface.
(B) Genuine watermarks are directly printed using specialized translucent white ink, whereas counterfeits rely exclusively on faint grey surface ink.
(C) Genuine watermarks sit entirely on top of the paper fibers, whereas counterfeit watermarks are artificially embedded inside the paper pulp layer.
(D) Genuine watermarks are fluorescent features visible only under UV light, whereas counterfeit watermarks are visible exclusively under natural light.

Click Here to Buy book on Amazon

(A) ₹500
(B) ₹2000
(C) ₹100
(D) Both (A) and (B)

35. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Investigating officers must never physically mark suspected counterfeit currency with a pen or fold it unnecessarily before forensic submission.
Reason (R): Improper handling can alter trace evidence, introduce extraneous ink, and damage delicate paper or chemical characteristics essential for VSC analysis.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

36. Consider the following statements about detecting offset-printed counterfeit notes:
I. They exhibit a flat printing surface without tactile relief.
II. They often show a dot matrix structure under magnification due to halftone printing.
III. They possess genuine 100% cotton rag paper characteristics.
IV. Their micro-lettering is frequently blurred or illegible compared to genuine intaglio.
Which of the above statements are correct?
(A) I, II, and III only
(B) I, II, and IV only
(C) II, III, and IV only
(D) I, III, and IV only

37. Match the MGNS currency denomination in List I with its official base colour in List II.
List I
P. ₹10
Q. ₹50
R. ₹200
S. ₹500
List II
1. Bright Yellow
2. Stone Grey
3. Fluorescent Blue
4. Chocolate Brown
(A) P-4, Q-3, R-1, S-2
(B) P-3, Q-4, R-2, S-1
(C) P-4, Q-1, R-3, S-2
(D) P-1, Q-3, R-4, S-2

38. Select the correct standard chain-of-custody sequence for handling seized Fake Indian Currency Notes (FICN) at a crime scene:
(A) Seizure → Counting and cataloguing → Packing in transparent plastic bags → Direct handover to court
(B) Seizure → Immediate chemical spot testing → Packing in paper envelopes → Sealing → Forwarding to FSL
(C) Seizure → Defacing the notes with 'FAKE' stamps → Photography → Forwarding directly to Reserve Bank of India
(D) Seizure → Segregation and sampling → Packing in paper envelopes → Proper sealing with impression → Forwarding to FSL with a letter of request

39. What are the official dimensions of the MGNS ₹500 bank note?
(A) 63 mm × 150 mm
(B) 66 mm × 150 mm
(C) 66 mm × 166 mm
(D) 73 mm × 150 mm

40. The ₹1 currency note in India is unique because it bears the signature of the:
(A) The Governor of the Reserve Bank of India
(B) The Prime Minister of the Republic of India
(C) Finance Secretary, Government of India
(D) The Union Finance Minister of India

41. In the context of printing processes, intaglio transfers ink onto the paper from:
(A) The raised relief surfaces of a rubber offset blanket
(B) A finely stretched silk or synthetic mesh screen
(C) A smooth flat lithographic stone or aluminum plate
(D) The recessed grooves of an engraved metal plate

NODIA

42. During a preliminary laboratory examination, a suspected currency note is placed under a 365 nm UV lamp. The entire paper substrate glows with a bright blue/white fluorescence. What does this most likely indicate?
(A) The note uses commercial paper with optical brighteners and is likely fake.
(B) The note is an authentic specimen that has been inadvertently washed using domestic bleaching agents.

63. A suspected ₹500 note is examined and its security thread lacks any magnetic properties when tested with a magnetic flux detector. What is the standard forensic conclusion?
(A) The note is entirely genuine but its thread was accidentally demagnetized during high-speed ATM sorting.
(B) The note represents a rare genuine mint misprint where magnetic ink formulation was omitted.
(C) Magnetic security properties are exclusively restricted to ₹2000 denomination banknotes in this series.
(D) The note is counterfeit, as genuine threads are magnetic.

64. What are the official dimensions of the MGNS ₹2000 bank note?
(A) 66 mm × 150 mm
(B) 73 mm × 166 mm
(C) 66 mm × 166 mm
(D) 63 mm × 142 mm

65. If a criminal painstakingly draws additional zeros on a genuine ₹10 note to pass it off as a ₹1000 note, the resultant forgery is technically classified as a:
(A) Fabricated note
(B) Raised note
(C) Composite note
(D) Misregistered note

66. The colour-shifting effect in Optically Variable Ink (OVI) is caused by:
(A) Thermochromic organic pigments that reversibly change colour when exposed to human body heat
(B) Trace amounts of low-level radioactive isotopes directly incorporated into the chemical ink formula
(C) Simple excitation and absorption of ambient ultraviolet light by embedded synthetic fluorescent dyes
(D) Light interference within multi-layer thin film ink flakes

67. What is the foremost priority of the First Responding Officer upon seizing suspected counterfeit currency at a crime scene?
(A) To properly pack, seal, and maintain chain of custody
(B) To immediately carry out preliminary chemical ink spot testing on-site at the crime scene
(C) To securely staple all seized notes together in neat bundles categorized by denomination
(D) To write the crime identification case number directly onto the face of each note using a permanent marker

68. Under a stereomicroscope, a suspected counterfeit note shows a distinct pattern of tiny fused toner particles sitting on top of the paper surface, rather than ink absorbed into the fibres. Which counterfeiting method was most likely used?
(A) Hand-carved high-pressure intaglio steel plate engraving
(B) Traditional multi-colour wet offset lithography process
(C) Colour laser printer / photocopier
(D) Industrial continuous high-speed rotary letterpress

69. On genuine ₹500 and ₹2000 notes, both the Optically Variable Ink (OVI) numeral and the windowed security thread change colour from:
(A) Green to Blue
(B) Red to Blue
(C) Gold to Green
(D) Magenta to Yellow

70. To conclusively verify the perfect registration of the "See-through Register" on a currency note, an examiner must view the note using:
(A) Direct high-intensity incident (top) surface lighting
(B) Low-angle oblique (side) grazing incident lighting
(C) Coaxial vertical illumination and optical lighting
(D) Transmitted (back) lighting

71. On the MGNS ₹500 note, the micro-lettering 'RBI' and 'BHARAT' (in Hindi) are primarily found:
(A) Positioned directly inside the primary right-hand watermark window
(B) Left of the Mahatma Gandhi portrait
(C) Directly overprinted across the main serial numbering panel
(D) Printed continuously along the outer bottom reverse margin

72. Why is it extremely difficult for counterfeiters to perfectly replicate a genuine watermark using standard commercial paper?
(A) Commercial paper possesses an excessively high opacity and thickness that completely

Downloaded from www.pdf.tube

51. The Latent Image on genuine MGNS notes is typically found in which area of the note?
(A) On the vertical band right of the portrait
(B) Directly positioned within the central base area of the Ashoka Pillar emblem
(C) Interwoven directly at regular intervals within the windowed security thread
(D) Located precisely at the top left corner superimposed over the serial number panel

52. Which optical instrument is best suited for a forensic examiner to clearly observe and photograph the 'Bharat' and 'India' micro-lettering on a suspected note?
(A) Simple hand-held UV lamp
(B) Standard biological compound microscope at 1000x
(C) Stereomicroscope at 10x to 40x magnification
(D) Gas Chromatograph

53. Which Section of the Reserve Bank of India Act, 1934 gives the RBI the sole right to issue bank notes in India?
(A) Section 10
(B) Section 15
(C) Section 22
(D) Section 35

54. Which of the following commercial printing processes is NOT standardly used in the primary production of modern Indian bank notes?
(A) Offset lithography
(B) Intaglio
(C) Letterpress
(D) Flexography

55. The intentional design pattern on modern currency that signals scanning software and colour copiers to block the reproduction of the note is called the:
(A) Intricate Guilloche pattern
(B) EURion constellation
(C) High-frequency Moire fringe
(D) Precision Intaglio registry

56. Which specific security feature on the MGNS ₹500 note changes colour from green to blue when the note is tilted?
(A) The primary portrait of Mahatma Gandhi printed on the obverse
(B) The Ashoka Pillar emblem located on the bottom right side
(C) The denominational numeral 500
(D) The official guarantee signature of the RBI Governor

57. Identify the CORRECT pair of an MGNS note denomination and its defining base colour.
(A) ₹50 - Chocolate Brown
(B) ₹500 - Fluorescent Blue
(C) ₹2000 - Stone Grey
(D) ₹200 - Bright Yellow

58. In the context of modern currency security, what does the acronym OVD stand for?
(A) Optically Variable Device
(B) Optical Validation Document
(C) Obverse Vision Display
(D) Optic Verification Datum

59. In genuine Indian banknotes, the electrotype watermark typically displays:
(A) The RBI Governor's signature
(B) The denominational numeral
(C) The national emblem
(D) The Swachh Bharat logo

NODIA

60. What specific chemical additives (sizing agents) combined with cotton rag fibres give genuine Indian currency paper its characteristic strength and "crisp" sound?
(A) Precipitated calcium carbonate and fine talc powder fillers
(B) Melamine formaldehyde wet-strength resins
(C) Inert polyvinyl chloride (PVC) plastisol dispersions
(D) Aqueous solutions of concentrated sodium hypochlorite

61. A high-quality counterfeit note is produced using offset printing. Which vital tactile characteristic of a genuine note will this counterfeit fail to replicate?
(A) The tactile raised printing effect
(B) The precise physical length and width dimensions of the note
(C) The exact official multi-tonal base colour of the note
(D) The intricate background geometric guilloche patterns

62. The serial numbers on Indian currency notes are printed using which specific printing technology?
(A) Digital inkjet
(B) Intaglio
(C) Letterpress
(D) Screen printing

(C) The note is fully genuine, as authentic banknote paper substrate is formulated to fluoresce brightly.
(D) The ultraviolet light source is malfunctioning or operating at an incorrect emission wavelength.

43. Which specialised printing press ensures perfect front-to-back registration, necessary for creating the 'See-through Register' feature on Indian bank notes?
(A) High-precision intaglio web printing press
(B) Simultan (simultaneous) offset press
(C) Automated high-speed rotary letterpress
(D) Variable-data digital continuous feed press

44. Which of the following statements about coin counterfeiting is INCORRECT?
(A) Counterfeit coins are frequently manufactured using crude casting techniques with plaster or sand moulds.
(B) Counterfeit coins are detected via the 'See-through Register' feature.
(C) Counterfeit coins often display defective edge milling, uneven relief, or incorrect weight relative to genuine coins.
(D) Die stamping with custom engraved dies is utilized by sophisticated criminal networks to produce fake coins.

45. In forensic terminology, modifying the corner numerals of a genuine ₹10 note to make it appear as a ₹100 note is categorized as:
(A) An altered or raised note
(B) A laterally split or peeled note
(C) A fraudulently pasted note
(D) An offset lithographic counterfeit

46. What specific method involves splitting a genuine note in half laterally, and pasting a printed fake reverse onto the genuine obverse, effectively doubling the yield for the counterfeiter?
(A) High-precision double-sided offset lithography
(B) Artificial surface watermark manipulation
(C) Split-note counterfeiting
(D) Advanced electrotype intaglio cloning

47. Consider the following specific features of genuine Indian bank notes observable under a Video Spectral Comparator (VSC):
I. Intaglio inks may appear opaque under infrared (IR) light while offset inks may become transparent (IR drop-out).
II. The security thread fluoresces differently depending on the viewing angle and UV wavelength.
III. Micro-lettering remains perfectly crisp and legible at high optical magnification.
Which of the above statements are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

48. What creates the watermark effect in genuine currency paper?
(A) Heavy local application of opaque white ink onto the outer surface of the finished paper
(B) Mechanically embossing finished dry paper under high temperature using a heated metal die
(C) Varying fibre density in the wet paper pulp during manufacture
(D) Adhering a specialized translucent polymer patch directly over the designated window area

49. A suspected note has a security thread that appears as a solid grey line drawn on the surface with a pencil. If a Forensic Examiner gently scrapes it, the line smudges. This confirms that:
(A) The note is fully genuine but has suffered severe physical wear and chemical erosion.
(B) The thread is simulated, confirming a counterfeit note.
(C) The note represents a genuine production defect originating directly from the RBI printing press.
(D) The optically variable printing ink has undergone severe chemical degradation over time.

50. What is the primary forensic purpose of adding dual-coloured optical fibres to currency paper during manufacturing?
(A) To significantly increase the structural tensile strength and durability of the paper substrate
(B) To impart a distinctively rough tactile feel across the non-printed areas of the note
(C) To facilitate the formation of the multi-tonal watermark portrait during wet-pulp moulding
(D) To serve as a security feature visible under UV light

Click Here to Buy book on Flipkart

blocks light transmission.
(B) Commercial paper substrate chemically degrades and dissolves immediately when exposed to watermarking fluids.
(C) Genuine watermarks are structural, formed by wet pulp density variation.
(D) Commercial paper surfaces contain protective sizing agents that actively repel standard watermarking inks.

73. When checking the number panel of a genuine MGNS currency note under a 365 nm UV light, a forensic examiner will typically observe:
(A) The numbers become completely invisible.
(B) The numbers migrate to the opposite side of the note.
(C) The panel turns deep red, completely hiding the numbers.
(D) The numbers exhibit strong fluorescence.

74. Which of the following is NOT a common method utilized in the counterfeiting of metallic coins?
(A) Offset lithography
(B) Casting using plaster moulds
(C) Die stamping with counterfeit dies
(D) Electroplating base metals

75. In the case of a bulk seizure of 50,000 suspected counterfeit notes, what is the accepted procedure for forensic laboratory submission?
(A) Forward every single seized banknote without exception to the laboratory for comprehensive individual analysis.
(B) Submit a representative sample covering all variations.
(C) Select and submit exclusively a single note representing the highest face value denomination among the seized stock.
(D) Immediately order the total destruction of all seized notes under police supervision to stop illicit circulation.

76. Which feature of the Mahatma Gandhi portrait on Indian currency notes is printed using Intaglio?
(A) Exclusively the frame of the spectacles worn in the image
(B) The main portrait, giving a tactile raised feel
(C) Exclusively the outer line profile drawing of the face
(D) None of the portrait, as it is produced entirely via offset lithography

77. The 'bleed lines' printed on the edges of higher denomination currency notes are specifically designed to assist:
(A) Visually impaired persons in identifying denomination
(B) Commercial bank tellers during high-speed manual sorting and cash counting operations
(C) Automated teller machines (ATMs) in determining correct note directional orientation
(D) Forensic document examiners in rapidly detecting evidence of chemical washing or bleaching

78. What is the official base colour of the MGNS ₹200 bank note?
(A) Stone Grey
(B) Magenta
(C) Bright Yellow
(D) Fluorescent Blue

79. A common commercial "counterfeit detection pen" relies on a chemical reaction between an iodine solution in the pen and which substance typically found in common fake paper?
(A) Lignin
(B) Cellulose
(C) Melamine
(D) Starch

80. In India, which specialised database/agency group is tasked with monitoring Fake Indian Currency Note (FICN) trends, maintaining records, and coordinating at the national level?
(A) National Crime Records Bureau (NCRB) Cyber Cell
(B) Serious Fraud Investigation Office (SFIO)
(C) FICN Coordination Group (FCORD)
(D) Indian Computer Emergency Response Team (CERT-In)

81. Which of the following describes a "composite" counterfeit note?
(A) A counterfeit banknote produced entirely through multi-stage high-resolution offset lithography
(B) A note assembled from parts of genuine and fake notes
(C) A modern non-paper note printed on a specialized flexible pure synthetic polymer substrate
(D) A specialized counterfeit note where serial numbers are overprinted using magnetic ink

Downloaded from www.pdf.tube

26. Match the IPC sections in List I with their corresponding counterfeit-related offences in List II.

List I

P. Section 489A
Q. Section 489B
R. Section 489C
S. Section 489D

List II

1. Making or possessing instruments or materials for forging currency-notes
2. Counterfeiting currency-notes or bank-notes
3. Possession of forged or counterfeit currency-notes
4. Using as genuine, forged or counterfeit currency-notes

(A) P-2, Q-4, R-3, S-1
(B) P-1, Q-2, R-4, S-3
(C) P-4, Q-3, R-1, S-2
(D) P-2, Q-3, R-4, S-1

27. The principle underlying Optically Variable Ink (OVI) in modern banknotes is primarily based on which optical phenomenon?
(A) Phosphorescence
(B) Thin-film interference
(C) Birefringence
(D) Total internal reflection

28. How many angular bleed lines are present on the MGNS ₹2000 bank note?
(A) 4
(B) 5
(C) 6
(D) 7

29. Which instrument is universally accepted as the standard for the non-destructive optical examination of questioned currency notes in forensic science laboratories?
(A) Video Spectral Comparator (VSC)
(B) Gas Chromatograph-Mass Spectrometer (GC-MS)
(C) Scanning Electron Microscope (SEM)
(D) Atomic Absorption Spectrophotometer (AAS)

30. Consider the following statements regarding the watermark in MGNS bank notes:
I. It contains a portrait of Mahatma Gandhi.
II. It incorporates a multidirectional line design.
III. It features an electrotype denominational numeral.
Which of the above statements are correct?
(A) I and II only
(B) I and III only
(C) II and III only
(D) I, II, and III

NODIA

31. Under a stereomicroscope, how do the printed lines of a counterfeit note produced by standard inkjet printing typically appear?
(A) They display a sharp, continuous line border showing a distinct outer ink squeeze halo effect.
(B) They exhibit thick, highly raised deposits of ink sitting distinctly above the paper substrate.
(C) They appear as uniformly dark, perfectly continuous solid lines across the entire substrate.
(D) They consist of scattered CMYK dots without sharp, continuous edges.

32. Arrange the standard steps for sampling bulk seized counterfeit currency for submission to a Forensic Science Laboratory:
I. Random selection of representative notes from each category
II. Segregation of the seized notes by denomination and apparent series
III. Sealing of the representative samples in secure paper envelopes
IV. Tagging and initialing the selected samples without defacing security features
(A) I, II, III, IV
(B) II, IV, I, III
(C) II, I, IV, III
(D) I, III, II, IV

33. The 'EURion constellation' found on modern Indian currency notes serves what specific security function?
(A) It produces a characteristic red fluorescence when exposed to specialized infrared radiation sources.
(B) It triggers software lockouts in scanners and copiers to block reproduction.
(C) It incorporates a highly embossed tactile pattern designed specifically to aid visually impaired handlers.
(D) It generates a distinct machine-readable magnetic signature verified during automatic processing by ATMs.

34. Which of the following MGNS denominations does NOT feature Optically Variable Ink (OVI) on the denominational numeral?

ANSWERS

1. (B) Section 489B
Section 489B of the Indian Penal Code penalizes the act of using as genuine any forged or counterfeit currency notes or bank notes. The law targets individuals who sell, buy, receive, or otherwise traffic in fake currency despite knowing or having reason to believe that the notes are fraudulent, thereby safeguarding the nation's financial system against illegal currency circulation.

2. (D) 100% Cotton rag
Genuine Indian currency paper is manufactured using one hundred percent cotton rag rather than standard wood pulp paper. This pure cotton substrate gives banknotes high tensile strength, durability, resistance to wear and tear, and a distinctive crisp feel during handling. Additionally, cotton paper substrate is naturally dull under ultraviolet light exposure, assisting in forensic counterfeit detection.

3. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Intaglio printing creates a distinctive raised tactile effect on genuine currency notes because the process utilizes high mechanical pressure to force cotton paper into ink-filled, recessed grooves on metal plates. As the paper absorbs ink from the engraved relief design, it forms a raised layer that can be physically felt, providing a primary tactile anti-counterfeiting security feature.

4. (C) P-2, Q-4, R-1, S-3
Security features on Indian currency notes exhibit distinct characteristic visual appearances under standard examination conditions:
Optically variable ink shifts colour from green to blue upon tilting. The latent image reveals its denominational numeral when held horizontally at eye level. The watermark becomes visible against transmitted light, while the see-through register aligns perfectly on obverse and reverse views when held against light.

5. (D) I, II, and III
The security thread embedded in genuine Mahatma Gandhi New Series ₹500 notes incorporates multiple security elements. It is windowed on the obverse but forms a continuous line when viewed against transmitted light. Additionally, the thread changes colour from green to blue when tilted and possesses magnetic along with machine-readable properties designed for automated currency verification systems.

6. (D) On Mahatma Gandhi's collar and adjacent obverse areas
Micro-lettering on Mahatma Gandhi New Series banknotes consists of minute text patterns visible only under optical magnification. On the ₹500 note, these microscopic features containing recurring text such as RBI and BHARAT are positioned specifically on Mahatma Gandhi's collar as well as adjacent obverse areas, serving as an effective anti-counterfeiting measure against lower-resolution scanning devices.

7. (C) 2016
The Mahatma Gandhi New Series of banknotes was official introduced by the Reserve Bank of India in November 2016 following the demonetization of high-denomination currency. This series featured updated dimensions, new base colours, revised cultural heritage motifs on the reverse, and enhanced overt and covert security features designed to deter counterfeiting activities.

8. (C) The background tints and geometric patterns are printed using the intaglio process.
In genuine Indian currency, subtle background tints and multi-coloured geometric patterns are produced using offset lithography or simultan printing, not intaglio. Intaglio printing is reserved for primary focal elements like portraits, emblems, denominational numbers, and tactile bleed lines, which require raised ink features to provide tactile feedback and high-definition detail for security verification.

9. (D) II, IV, III, I
Forensic examination of suspected counterfeit currency proceeds logically from simple non-destructive visual checks to complex instrumental analysis. Initial inspection relies on naked eye visual and tactile examination, followed by

Click Here to Buy book on Amazon

is tilted at an angle, both transition smoothly to a distinct blue colour.

70. (D) Transmitted (back) lighting
To accurately evaluate the alignment of a see-through register, the banknote must be viewed using transmitted lighting, where light passes directly through the paper from behind. Transmitted light allows front and reverse printed patterns to overlay visually, revealing whether the geometric elements align perfectly to complete the design.

71. (B) Left of the Mahatma Gandhi portrait
On the obverse side of the Mahatma Gandhi New Series ₹500 banknote, micro-lettering containing the words RBI and BHARAT in Hindi is located specifically on the vertical region to the left of Mahatma Gandhi's portrait. These tiny characters require optical magnification to read and serve as a anti-counterfeiting measure.

72. (C) Genuine watermarks are structural, formed by wet pulp density variation.
Replicating genuine watermarks is extremely challenging for counterfeiters because authentic watermarks are structural features created during wet paper manufacturing by varying pulp fiber density. Printed or stamped imitations on finished commercial paper lack multi-tonal depth, internal pulp variations, and proper light transmission properties observed under forensic examination.

73. (D) The numbers exhibit strong fluorescence.
When the number panels of a genuine Mahatma Gandhi New Series banknote are examined under 365 nanometer ultraviolet light, the printed serial numbers display bright fluorescence. Fluorescent compounds present in the letterpress ink absorb UV energy and re-emit visible light, helping forensic examiners verify note authenticity quickly.

74. (A) Offset lithography
Offset lithography is a planar technique designed for printing on flexible substrates like paper and is completely unsuitable for manufacturing metallic coins. Coin counterfeiting relies instead on processes applicable to metals, such as casting with plaster or sand moulds, die striking using fake dies, and electroplating cheap base metal cores.

75. (B) Submit a representative sample covering all variations.
When handling large bulk seizures of suspected counterfeit currency, official forensic procedures dictate selecting and submitting a representative sample covering all observed denominations, series variations, and printing techniques. Submitting thousands of identical notes creates unnecessary laboratory backlogs, while representative sampling allows comprehensive expert analysis and legal reporting.

76. (B) The main portrait, giving a tactile raised feel
The primary portrait of Mahatma Gandhi on genuine Indian currency notes is printed using the intaglio process. This high-pressure engraving method deposits thick, raised ink layers on the paper, giving the portrait a distinct tactile feel that can be easily recognized by touch, serving as a primary security feature.

NODIA

77. (A) Visually impaired persons in identifying denomination
The angular bleed lines printed in intaglio on the obverse margins of higher denomination Indian banknotes are specifically engineered as tactile features to aid visually impaired individuals. By feeling the raised, tactile line patterns along note edges, visually impaired users can independently identify specific banknote denominations with confidence.

78. (C) Bright Yellow
The Mahatma Gandhi New Series ₹200 banknote features Bright Yellow as its official base colour. This distinctive color choice helps the public and cash handlers quickly identify the denomination, while complementary background graphic tints printed via offset lithography provide visual harmony and enhanced security against casual counterfeiting.

79. (D) Starch
Commercial counterfeit detection pens contain an iodine solution that reacts chemically with starch present in common commercial wood pulp paper. When applied to standard paper, the iodine binds with starch molecules to produce a dark blue or black mark, whereas genuine banknote paper made from cotton rag lacks starch and remains unstained.

19. (A) The numeral 2000
The see-through register on the Mahatma Gandhi New Series ₹2000 banknote forms the denominational numeral 2000. Half of the numeral design is printed on the obverse side and the remaining matching portion on the reverse. When held up against transmitted light, both sides align perfectly to display a complete, continuous single image.

20. (B) 5 lines
The Mahatma Gandhi New Series ₹500 banknote incorporates five angular bleed lines printed in raised intaglio ink on both the left and right edges of the obverse side. These tactile lines, along with a specialized identification symbol, are designed specifically to assist visually impaired individuals in accurately identifying note denominations through touch.

21. (A) Ashoka Pillar Series → Mahatma Gandhi Series 1996 → Mahatma Gandhi Series 2005 → Mahatma Gandhi New Series
Indian currency history reflects a progressive development of note designs and security features. Following independence, the Ashoka Pillar Series served as the primary currency framework. This was succeeded by the Mahatma Gandhi Series introduced in 1996, updated with enhanced security features in 2005, and ultimately replaced by the current Mahatma Gandhi New Series in 2016.

22. (D) Reserve Bank of India
Under statutory provisions, the Reserve Bank of India serves as the sole currency issuing authority in India for all banknote denominations ranging from ₹2 to ₹2000. The only exception is the one-rupee note, which is issued directly by the Government of India through the Ministry of Finance and functions as sovereign coin currency.

23. (B) ₹500 - Sun Temple, Konark
The pairing of the ₹500 banknote with the Sun Temple of Konark is incorrect. On Mahatma Gandhi New Series currency, the reverse side of the ₹500 banknote features the iconic Red Fort heritage site, whereas the Sun Temple at Konark is depicted on the reverse side of the lower-denomination ₹10 banknote.

24. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
The security thread on Mahatma Gandhi New Series notes appears as segmented metallic windows on the surface but forms an unbroken continuous dark line when held against transmitted light. This visual phenomenon occurs because the thread is interwoven directly into wet paper pulp during manufacturing, physically embedding it inside the substrate structure.

25. (B) I, II, and IV only
A Video Spectral Comparator is an advanced non-destructive optical instrument used in document analysis. It examines banknotes across ultraviolet, visible, and infrared light spectrums, measures paper fluorescence, and identifies infrared absorbent or transparent inks. However, it does not perform destructive chemical ink analysis, preserving the physical integrity of questioned evidentiary documents.

26. (A) P-2, Q-4, R-3, S-1
The Indian Penal Code details currency offences under distinct statutory sections:
Section 489A covers the act of counterfeiting currency notes. Section 489B addresses using forged currency as genuine. Section 489C penalizes the possession of fake currency notes. Section 489D prohibits making or possessing instruments and materials intended for forging currency notes.

27. (B) Thin-film interference
Optically Variable Ink relies on the physical phenomenon of thin-film interference within multi-layer optical flakes suspended in the ink formulation. When light strikes these microscopic structures, light waves reflect across different internal boundaries, creating interference patterns that cause observed ink colours to shift dynamically depending on the angle of illumination and viewing.

28. (D) 7
The Mahatma Gandhi New Series ₹2000 banknote features seven angular bleed lines printed in intaglio on both the left and right obverse margins. These raised lines, combined with a rectangle symbol above the Ashoka Pillar emblem, function as a tactile identification system enabling visually impaired individuals to distinguish high-denomination currency notes.

Downloaded from www.pdf.tube

90. (A) Genuine watermarks stem from paper pulp density variation; counterfeits are printed on the surface.

The primary physical difference in watermark application lies in structural integration. Genuine watermarks are formed during wet paper pulp manufacturing by varying fiber density across specific zones, producing multi-tonal depth under transmitted light. Counterfeit watermarks are typically simulated on finished paper surfaces using printed faint ink, oil stamping, or surface embossing.

www.nodia.in

NODIA

breathable paper envelopes, seal packages with clear wax impressions, and forward them to a laboratory with an official letter of request.

39. (B) 66 mm × 150 mm
The official physical dimensions of the Mahatma Gandhi New Series ₹500 banknote are exactly 66 millimeters in height by 150 millimeters in width. Physical measurements are crucial in forensic document examination because genuine currency production adheres strictly to standard dimensional tolerances, helping experts identify improperly sized counterfeit notes.

40. (C) Finance Secretary, Government of India
Unlike higher denomination banknotes issued by the Reserve Bank of India which feature the Governor's signature, the one-rupee currency note is issued directly by the Government of India. Consequently, it bears the printed signature of the Finance Secretary of the Government of India, reflecting its legal status as direct government liability.

41. (D) The recessed grooves of an engraved metal plate
Intaglio printing relies on heavy mechanical pressure to transfer thick paste ink directly from recessed grooves engraved into a metal plate onto paper substrate. Under high pressure, paper fibers are forced into these grooves, absorbing ink and forming raised, highly detailed lines that produce a distinct tactile feel on genuine banknotes.

42. (A) The note uses commercial paper with optical brighteners and is likely fake.
Genuine currency substrate is manufactured from pure cotton rag without optical brightening agents, making it naturally dull under 365 nanometer ultraviolet illumination. If an entire banknote glows brightly under ultraviolet light, it indicates commercial wood pulp paper containing fluorescent optical brighteners was used, strongly signaling a counterfeit document.

43. (B) Simultan (simultaneous) offset press
The see-through register feature requires absolute precision front-to-back printing alignment, achieved through specialized Simultan offset printing presses. These high-precision presses print background graphic patterns on both sides of the currency paper simultaneously during a single pass, ensuring exact optical alignment when the note is viewed against transmitted light sources.

44. (B) Counterfeit coins are detected via the 'See-through Register' feature.
The see-through register is an optical printing feature unique to paper currency banknotes and is not present on metallic coins. Coin examination relies instead on analyzing physical properties such as metallic alloy composition, total weight, precise diameter, thickness, edge milling details, rim sharpness, and die strike relief quality.

45. (A) An altered or raised note
In forensic questioned document terminology, modifying genuine lower-denomination banknotes to give them the appearance of higher-value currency is classified as an altered or raised note. Counterfeiters alter corner numerals, written text, or denomination symbols using manual drawing, bleaching, or patch pasting to deceive handlers into accepting low-value notes as higher denominations.

46. (C) Split-note counterfeiting
Split-note counterfeiting involves carefully splitting a genuine banknote laterally into two thin layers, separating the obverse face from the reverse face. The counterfeiter then pastes a fake reproduction onto the reverse of each genuine half, producing two composite notes that each contain one genuine side, intended to bypass casual visual checks.

47. (D) I, II, and III
Under Video Spectral Comparator analysis, genuine Indian banknotes display specific characteristics. Intaglio inks show distinctive infrared drop-out properties where certain printed elements disappear under specific infrared wavelengths, security threads display angular UV fluorescence, and micro-printed text retains crisp structural clarity under high optical magnification without blurring or bleeding.

48. (C) Varying fibre density in the wet paper pulp during manufacture
Genuine watermarks are multi-tonal structural features integrated directly into currency paper during initial manufacturing. By altering paper pulp fiber density on a dandy roll while the wet pulp sheet is being formed, varying degrees of opacity and translucency are created, resulting in

Click Here to Buy book on Flipkart

29. (A) Video Spectral Comparator (VSC)
The Video Spectral Comparator is universally recognized as the essential non-destructive instrument for examining questioned currency notes in forensic laboratories. By utilizing various light sources from ultraviolet to infrared, variable magnification, and specialized optical filters, it allows examiners to analyze fluorescence, ink properties, micro-lettering, and security features without damaging banknote evidence.

30. (D) I, II, and III
The watermark window in Mahatma Gandhi New Series banknotes contains multiple integrated structural features. It includes a multi-tonal portrait of Mahatma Gandhi, multidirectional geometric line designs incorporated into the paper structure, and an electrotype watermark displaying the specific numerical denomination, all formed by varying pulp density during paper substrate manufacturing.

31. (D) They consist of scattered CMYK dots without sharp, continuous edges.
Under stereomicroscopic examination, counterfeit banknotes produced using standard commercial inkjet printers display fine scattered cyan, magenta, yellow, and black ink droplets across the paper surface. Unlike genuine intaglio or offset printing, inkjet lines lack crisp continuous borders, showing jagged edges and dot matrix patterns where liquid ink droplets bled into fibers.

32. (C) II, I, IV, III
Sampling seized counterfeit currency for forensic laboratory submission follows a standard procedural order:
First, seized notes are segregated by denomination and series. Next, representative notes are selected randomly from each category. These selected samples are then tagged and initialed without damaging security features, and finally sealed securely inside paper envelopes.

33. (B) It triggers software lockouts in scanners and copiers to block reproduction.
The EURion constellation is a pattern of small, precise ring symbols embedded within background banknote graphics worldwide. Digital imaging software, colour photocopiers, and desktop scanners detect this specific geometric spatial configuration during scanning routines, triggering immediate software lockouts that prevent unauthorized processing, reproduction, or printing of banknote images.

34. (C) ₹100
In the Mahatma Gandhi New Series, Optically Variable Ink is applied to denominational numerals exclusively on higher denomination notes such as ₹200, ₹500, and ₹2000. Lower denomination notes like the ₹100 note do not feature Optically Variable Ink on their denominational numerals, utilizing standard offset or intaglio inks instead.

35. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Investigating officers must refrain from writing, stamping, stapling, or folding suspected counterfeit banknotes during handling. Physical defacing or improper packaging can obscure delicate micro-lettering, introduce extraneous chemical contamination, damage paper fibers, and interfere with non-destructive optical testing, such as Video Spectral Comparator analysis carried out by forensic document experts.

36. (B) I, II, and IV only
Counterfeit notes produced via offset printing present distinct physical features. They display flat surfaces without intaglio tactile relief, frequently exhibit halftone dot structures under microscopic viewing, and often show blurred micro-lettering. They lack genuine cotton rag paper characteristics, as counterfeiters typically use commercial wood pulp paper containing optical brighteners.

37. (A) P-4, Q-3, R-1, S-2
Each banknote denomination in the Mahatma Gandhi New Series is distinguished by a specific official base colour: The ₹10 note features Chocolate Brown, the ₹50 note displays Fluorescent Blue, the ₹200 note is printed in Bright Yellow, and the ₹500 note utilizes Stone Grey as its primary base colour scheme.

38. (D) Seizure → Segregation and sampling → Packing in paper envelopes → Proper sealing with impression → Forwarding to FSL with a letter of request
Chain-of-custody protocols for seized counterfeit currency require systematic steps to preserve evidence integrity. Officers must perform initial seizure, segregate notes by category, extract representative samples, pack items securely in

NODIA

representation of the specific denominational numeral. Created during paper manufacturing using fine wire mesh patterns attached to the dandy roll, it creates a crisp, clear numerical area that becomes prominently visible when viewed against transmitted light.

60. (B) Melamine formaldehyde wet-strength resins
During banknote paper manufacturing, sizing agents such as melamine formaldehyde wet-strength resins are added to pure cotton rag fibers. These specialized chemical additives significantly improve wet tensile strength, increase fold endurance, enhance resistance to moisture and tearing, and impart the characteristic crisp sound or rattle associated with genuine banknotes.

61. (A) The tactile raised printing effect
Offset lithography is a planar printing process where ink is transferred evenly onto paper from flat plates, resulting in completely smooth ink surfaces. Consequently, offset-printed counterfeit notes fail to replicate the raised tactile feel characteristic of genuine intaglio printing used on main portraits, emblems, and edge bleed lines.

62. (C) Letterpress
Serial numbers on Indian currency notes are printed using letterpress technology. In this relief printing process, ink is applied to raised metallic numbering wheels and pressed directly into banknote paper, producing clear sequential alphanumeric characters characterized by distinct inked borders and minor physical indentations around character edges.

63. (D) The note is counterfeit, as genuine threads are magnetic.
The windowed security thread on genuine Indian currency notes is embedded with specialized magnetic materials designed for automated machine authentication. If testing with a magnetic detector reveals a total absence of magnetic properties within the thread, the examiner can conclusively classify the banknote as a counterfeit reproduction.

64. (C) 66 mm × 166 mm
The official physical dimensions of the Mahatma Gandhi New Series ₹2000 banknote are 66 millimeters in height by 166 millimeters in width. Physical dimensional analysis is an essential forensic step, as genuine banknotes are produced to strict size standards, making length and width deviations key indicators of counterfeiting.

65. (B) Raised note
A genuine banknote modified by manually adding zeros or altering corner numerals to project a higher face value is legally and forensically classified as a raised note. Counterfeiters alter existing genuine notes to deceive victims into accepting low-denomination currency at a inflated valuation without manufacturing an entire fake note.

NODIA

66. (D) Light interference within multi-layer thin film ink flakes
The striking colour-shifting behavior of Optically Variable Ink is produced by light interference occurring within microscopic multi-layer thin-film flakes embedded in the ink matrix. As viewing angles change, light reflecting off internal structures interferes constructively and destructively, altering observed wavelengths and causing smooth visual transitions between colours.

67. (A) To properly pack, seal, and maintain chain of custody
Upon seizing suspected counterfeit currency at a crime scene, the first responding officer's primary duty is to ensure proper packaging, secure sealing, and meticulous chain of custody maintenance. Physical marking, stapling, on-site chemical testing, or defacing evidence must be avoided to prevent altering microscopic or chemical properties prior to laboratory evaluation.

68. (C) Colour laser printer / photocopier
Under microscopic examination, fused plastic toner particles sitting directly on top of paper fibers indicate electrophotographic reproduction via a colour laser printer or photocopier. Unlike liquid inks that penetrate cotton rag fibers, laser toners are melted onto paper surfaces during thermal fusing, leaving raised resinous deposits without fiber absorption.

69. (A) Green to Blue
On genuine Mahatma Gandhi New Series ₹500 and ₹2000 banknotes, both the windowed security thread and the Optically Variable Ink denominational numeral feature matching colour-shifting properties. When viewed directly, these elements appear green, but when the note

ultraviolet light viewing to check fluorescence. Next, stereomicroscopic examination reveals fine printing details and paper fibers, concluding with Video Spectral Comparator analysis for advanced spectral verification.

10. (A) Green to Blue
Optically Variable Ink used on higher denomination Mahatma Gandhi New Series banknotes, such as the ₹500 and ₹2000 notes, displays a prominent colour-shifting visual effect. When the note is held flat, the denominational numeral appears green, but when tilted at an angle relative to incident light, the colour transitions smoothly to blue.

11. (B) The serial numbering panel
The serial numbering panel on Indian bank notes is printed using the letterpress process, which creates uniform inked characters with slight edge indentations. In contrast, intaglio printing is utilized for major features requiring a raised tactile feel, including the portrait of Mahatma Gandhi, the Ashoka Pillar emblem, and angular bleed lines located along the margins.

12. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Counterfeit bank notes produced using commercial colour photocopiers lack the distinct tactile raised feel characteristic of genuine notes. This occurs because laser photocopiers utilize electrophotography, where plastic toner particles are heat-fused onto the paper surface. This process results in a flat finish, unlike genuine intaglio printing which forces paper pulp into engraved plates under pressure.

13. (A) I, II, and III only
Genuine Indian currency paper exhibits a characteristic crisp sound or rattle, remains dull under ultraviolet illumination, and incorporates synthetic dual-coloured fluorescent optical fibres embedded directly into the pulp during manufacturing. High concentrations of wood pulp are avoided because authentic banknotes rely entirely on cotton rag substrate to ensure chemical durability and high tensile physical strength.

14. (C) Horizontally at eye level and tilted against light
The latent image security feature on genuine Indian banknotes is designed to reveal hidden denominational numbers only under specific viewing geometry. To observe this covert feature, the note must be held horizontally at eye level and slightly tilted against incident light, allowing light interaction with intaglio-printed lines to reveal the concealed numeral.

15. (D) P-3, Q-2, R-4, S-1
Printing processes correspond to specific currency features based on technical design requirements: Letterpress prints sequential serial numbers with character borders. Offset lithography generates multi-coloured background tints. Intaglio creates heavy raised ink deposits for the Ashoka Pillar emblem and edge bleed lines. Simultan press printing enables precise front-to-back alignment needed for see-through register motifs.

16. (C) National Investigation Agency (NIA)
The National Investigation Agency is the specialized central agency in India specifically empowered to investigate offences related to Fake Indian Currency Notes when cases involve national security implications or terror funding networks. Established under national legislation, the agency coordinates inter-state and international intelligence to dismantle organized counterfeit currency syndicates threatening economic security.

17. (B) The serial numbers fluoresce brightly.
Under ultraviolet light emitting at 365 nanometers, the serial number panels on genuine Mahatma Gandhi New Series ₹500 notes display bright fluorescence. Special fluorescent pigments incorporated into the letterpress printing ink absorb invisible shortwave ultraviolet radiation and re-emit it as vivid visible light, serving as a reliable feature during forensic document verification.

18. (A) I and II only
Criminal counterfeiters commonly employ modern digital reprographic techniques such as high-resolution colour laser photocopying, desktop scanning, and inkjet printing to fabricate fake bank notes. Watermark embedding through paper pulp density variation is a complex industrial manufacturing process restricted to specialized paper mills, making it impossible for counterfeiters to replicate using standard printing methods.

Downloaded from www.pdf.tube

80. (C) FICN Coordination Group (FCORD)
The Fake Indian Currency Notes Coordination Group is the specialized nodal entity in India tasked with monitoring fake currency trends, maintaining centralized crime databases, and coordinating intelligence sharing between state police departments and central security agencies to combat organized counterfeit currency distribution networks across national boundaries.

81. (B) A note assembled from parts of genuine and fake notes
A composite counterfeit note refers to a fraudulent banknote constructed by combining parts extracted from genuine banknotes with counterfeit sections or pieces from different notes. By piecing together authentic segments containing valid security features with fake portions, counterfeiters attempt to deceive automated counting machines and casual visual inspections.

82. (D) Intaglio shows thick ink piled above paper; letterpress shows ink squeeze at character edges.
Under microscopic examination, intaglio printing shows thick ink layers resting visibly above paper surfaces, forming raised tactile relief patterns. Conversely, letterpress printing presses relief type into paper under pressure, pushing liquid ink outward toward character margins to produce a characteristic outer rim or ink squeeze halo around printed text edges.

83. (A) On the vertical band to the right of the portrait
The latent image feature on the Mahatma Gandhi New Series ₹500 banknote is located on the vertical band positioned immediately to the right of Mahatma Gandhi's portrait. Created with intaglio printing lines, this feature reveals the hidden numeral 500 when tilted horizontally at eye level under ambient light.

84. (C) Blend of 75% cotton and 25% linen
In forensic questioned document analysis, United States currency paper substrate is notable for its specific material composition, consisting of a blend of seventy-five percent cotton and twenty-five percent linen. This blend, combined with embedded red and blue synthetic security fibers, grants federal banknotes high physical durability and distinct tactile characteristics.

85. (A) Government of India (Finance Ministry)
The one-rupee currency note is unique within Indian currency systems because it is issued directly by the Government of India through the Ministry of Finance, rather than the Reserve Bank of India. Consequently, it bears the printed signature of the Finance Secretary and represents an direct sovereign liability of the central government.

86. (D) IR drop-out
Infrared drop-out is a covert security feature where specific inks used in banknote printing become invisible or transparent under specialized infrared radiation wavelengths. During infrared examination, background patterns or portrait details printed with infrared-transparent inks drop out from view, while infrared-absorbent ink features remain visible, confirming document authenticity.

87. (B) Red Fort
The reverse side of the Mahatma Gandhi New Series ₹500 banknote depicts an artistic rendering of the Red Fort, a historic UNESCO World Heritage site located in New Delhi. This cultural heritage motif is accompanied by the national flag and the Swachh Bharat logo, highlighting Indian cultural national heritage.

NODIA

88. (C) Section 489C IPC
Section 489C of the Indian Penal Code codifies the criminal offence regarding possession of forged or counterfeit currency notes or banknotes. To establish liability under this section, the prosecution must prove that the accused possessed fake notes, knew or had reason to believe them forged, and intended to use them as genuine.

89. (D) Questioned Document Section
Suspected counterfeit currency notes submitted for forensic analysis are examined primarily within the Questioned Document Section of a Forensic Science Laboratory. Specialized document examiners in this section evaluate paper composition, printing technologies, micro-lettering, ink optics, watermarks, and physical security features using non-destructive optical instruments like stereomicroscopes and spectral comparators.

a detailed watermark visible under transmitted light.

49. (B) The thread is simulated, confirming a counterfeit note.
Genuine banknotes feature windowed security threads physically embedded into paper substrate fibers during pulp manufacturing. A security thread simulated by drawing a pencil line on the surface that easily smudges when scraped indicates superficial surface manipulation, proving that the note is a counterfeit lacking authentic embedded security structures.

50. (D) To serve as a security feature visible under UV light
Dual-coloured synthetic optical fibres are incorporated randomly into paper pulp during currency manufacturing to serve as a covert security feature. While virtually invisible or inconspicuous under normal room lighting, these specialized security fibres fluoresce brightly in distinct colours when exposed to ultraviolet radiation, assisting forensic verification.

51. (A) On the vertical band right of the portrait
On Mahatma Gandhi New Series banknotes, the latent image feature is located on the vertical band positioned to the right of Mahatma Gandhi's portrait. Printed using high-precision intaglio lines, this covert security pattern reveals the hidden denominational numeral only when viewed horizontally at eye level against light.

52. (C) Stereomicroscope at 10x to 40x magnification
A stereomicroscope operating within low to moderate optical magnification levels, typically between ten and forty times, is best suited for forensic document examiners to view micro-lettering such as RBI and BHARAT. It provides clear three-dimensional visualization, excellent depth of field, and adequate spatial resolution without distorting printed substrate features.

53. (C) Section 22
Section 22 of the Reserve Bank of India Act, 1934 explicitly grants the Reserve Bank of India the sole statutory right to issue currency banknotes across India. This legal framework establishes the central bank's exclusive authority over national banknote design, production management, distribution, and overall currency supply regulation within the country.

54. (D) Flexography
Flexography is a high-speed packaging printing method utilizing flexible relief plates and liquid inks, but it is not employed in primary Indian banknote production. Authentic banknote manufacturing relies on specialized security printing processes, including offset lithography for background tints, intaglio for raised main elements, and letterpress for numbering panels.

55. (B) EURion constellation
The EURion constellation is a recognized anti-copying pattern consisting of specific geometric arrangements of small yellow, green, or orange rings embedded in banknote designs. Digital scanner software, image processing applications, and colour copiers detect these spatial mark configurations, automatically aborting printing or copying routines to prevent counterfeit currency creation.

56. (C) The denominational numeral 500
On the Mahatma Gandhi New Series ₹500 note, the denominational numeral 500 located at the bottom right obverse is printed using Optically Variable Ink. When the banknote is viewed straight on, the numeral appears green, but when tilted at an angle, it transitions smoothly to a distinct blue colour.

57. (D) ₹200 - Bright Yellow
In the Mahatma Gandhi New Series, the ₹200 banknote is officially designated with a distinctive Bright Yellow base colour. This distinctive color choice helps the public and cash handlers quickly identify the denomination, while complementary background graphic tints printed via offset lithography provide visual harmony and enhanced security against casual counterfeiting.

58. (A) Optically Variable Device
In currency printing and forensic document analysis, the acronym OVD stands for Optically Variable Device. OVDs are security features, such as holograms, metallic foils, or color-shifting inks, that display changing visual effects, dynamic patterns, or colour transitions when viewed from varying angles or under changing illumination conditions.

59. (B) The denominational numeral
The electrotype watermark on genuine Indian banknotes features a bright, highly detailed

Click Here to Buy book on Amazon

CHAPTER 27
Firearms and Ammunition

1. The study of forensic ballistics is traditionally divided into three fundamental branches. Which of the following accurately lists these three branches?
(A) Forward, Reverse, and Transitional ballistics
(B) Internal, External, and Terminal ballistics
(C) Primary, Secondary, and Tertiary ballistics
(D) Propellant, Trajectory, and Impact ballistics

2. Which branch of forensic ballistics specifically deals with the motion of the projectile and the conditions affecting it while it is inside the firearm barrel?
(A) External ballistics
(B) Terminal ballistics
(C) Transitional ballistics
(D) Internal ballistics

3. External ballistics is defined as the study of a projectile's flight behavior. At what exact point does the phase of external ballistics begin?
(A) The moment the projectile exits the muzzle of the firearm
(B) The moment the firing pin strikes the primer
(C) The moment the propellant begins to deflagrate
(D) The moment the projectile strikes the target

4. Which of the following aspects is primarily investigated under terminal ballistics?
(A) The angle of elevation of the firearm barrel
(B) The gyroscopic stability of the bullet in the air
(C) The behavior and effect of the projectile upon striking the target
(D) The pressure generated inside the cartridge case

5. Given below is a list of historical firearm ignition systems:
1. Flintlock
2. Matchlock
3. Percussion cap
4. Wheellock

Which of the following represents the correct chronological order of their invention and development?
(A) 2, 4, 1, 3
(B) 2, 1, 4, 3
(C) 4, 2, 1, 3
(D) 1, 2, 4, 3

6. Match the historical figures in List I with their major contribution to firearm development in List II.
List I: Historical Figure
P. Rev. Alexander Forsyth
Q. Samuel Colt
R. Hiram Maxim
S. Richard Gatling
List II: Contribution
1. Invented the fully automatic machine gun
2. Invented the percussion ignition system
3. Patented the hand-cranked multi-barrel gun
4. Popularized the mass-produced revolver
(A) P-2, Q-4, R-1, S-3
(B) P-4, Q-2, R-3, S-1
(C) P-2, Q-4, R-3, S-1
(D) P-1, Q-3, R-2, S-4

NODIA

7. What is the fundamental physical difference between a smooth bore firearm and a rifled firearm?
(A) A smooth bore weapon fires exclusively copper-jacketed bullets, while a rifled weapon fires only lead projectiles.
(B) A smooth bore firearm has a smooth internal barrel, while a rifled firearm has spiral grooves cut into its bore.
(C) A smooth bore firearm utilizes traditional black powder, while a rifled firearm uses only smokeless propellant.
(D) A smooth bore firearm requires manual reloading after each shot, while a rifled firearm is fully automatic.

8. In forensic firearm terminology, what defines a standard "revolver" as opposed to a "pistol"?
(A) A revolver utilizes expanding propellant gas pressure to eject spent cartridges, whereas a pistol requires manual hand ejection.
(B) A revolver fires heavy shotgun shells, whereas

2. Ensure the firearm is pointed in a safe direction and check if it is loaded (clearing the weapon).
3. Test for trace biological evidence (blood, tissue, or DNA) on the exterior grip.
4. Disassemble the weapon to examine the internal firing mechanism.

Which of the following represents the correct logical and safe order of these steps?
(A) 1, 2, 3, 4
(B) 2, 1, 3, 4
(C) 1, 3, 2, 4
(D) 2, 3, 1, 4

62. In modern factory-loaded shotgun ammunition, what material is primarily used to manufacture the one-piece shot wad?
(A) Moulded plastic
(B) Felt
(C) Cork
(D) Compacted paper

63. What is the purpose of the "crimp" at the front end of a shotgun shell?
(A) To rapidly ignite the main powder propellant mixture inside the cartridge
(B) To serve as the primary sensitive percussion primer for the shotgun shell
(C) To hold the shot pellets and wads securely in the case
(D) To provide an optimal aerodynamic shape for the shell casing during flight

64. In firearm mechanics, what does the term "headspace" refer to?
(A) The physical distance between the front iron sight and rear iron sight of a firearm
(B) The precise internal bore diameter of the barrel measured at the extreme muzzle end
(C) The structural space inside the removable box magazine where cartridges are stacked
(D) The distance from the closed breech face to the seating surface in the chamber

65. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Improvised firearms (country-made weapons) are notoriously unsafe and frequently burst during firing.
Reason (R): They are constructed using substandard materials lacking proper tensile strength and do not undergo standardized proof-testing for high chamber pressures.
In light of the above statements, choose the correct option:
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

66. Cartridge brass is the most common metallic material used for manufacturing modern centerfire cartridge cases. What is the typical alloy composition of cartridge brass?
(A) 90% Copper and 10% Tin
(B) 70% Copper and 30% Zinc
(C) 50% Copper and 50% Steel
(D) 100% pure annealed Copper

67. In shotgun terminology, what distinguishes "buckshot" from "birdshot"?
(A) Buckshot pellets are fabricated from hardened steel, whereas birdshot pellets are composed of lead.
(B) Buckshot is designed for rifled shotgun barrels, whereas birdshot is fired from smooth barrels.
(C) Buckshot shells contain a single solid slug, whereas birdshot shells contain multiple small pellets.
(D) Buckshot uses larger pellets for heavy game, while birdshot uses small pellets for fowl.

68. What is the primary purpose of a "cannelure" on a bullet?
(A) A groove into which the case mouth is crimped
(B) To significantly increase the initial muzzle velocity of the bullet
(C) To dramatically reduce the volume of smoke produced during propellant combustion
(D) To serve as an secondary external primer pocket for explosive projectile loads

69. Consider the following statements regarding the forensic characteristics of rifled barrels:
I. The number of lands and grooves is a class characteristic of the firearm.
II. The direction of twist (left or right) is a class characteristic of the firearm.
III. The microscopic striations inside the grooves are individual characteristics of the firearm.
IV. The calibre of the barrel is an individual characteristic of the firearm.
Which of the above statements are correct?

Downloaded from www.pdf.tube

STUDYING FROM PDFs?

THINK AGAIN.

If you are studying only from PDFs,
you are wasting valuable time.

Research shows that learning from

PRINTED BOOKS has up to

4× HIGHER RETENTION

than studying from screens.

PRINT BOOK = BETTER MEMORY

PDF = LOWER RETENTION

Those who study from **PRINTED BOOKS**
move **AHEAD.**

Others are left **BEHIND**
in competition.

In competitive exams,
being average is not enough.

STAY ONE STEP AHEAD.

17. Which internal component of a firearm specifically strikes the primer of the cartridge to initiate ignition?
(A) The ejector
(B) The firing pin
(C) The extractor
(D) The sear

18. Consider the following statements regarding the parts of a firearm:
I. The extractor pulls the fired cartridge case out of the chamber.
II. The ejector throws the fired cartridge case out of the firearm through the ejection port.
III. The magazine is a mechanism that solely ignites the propellant.
IV. The trigger sear holds the hammer or striker back until the trigger is pulled.
Which of the above statements are correct?
(A) I, II, and III only
(B) II, III, and IV only
(C) I, II, and IV only
(D) I, III, and IV only

19. In a firearm, what is the purpose of the extractor?
(A) To withdraw the spent case from the chamber
(B) To ignite the sensitive primary explosive mixture in the primer
(C) To catch and retain the fired bullet for comparison examination
(D) To impart a stabilizing gyroscopic spin to the bullet in the bore

20. In a standard semi-automatic pistol, what component is responsible for forcefully expelling the fired case away from the weapon once it is pulled clear of the chamber?
(A) The firing pin spring
(B) The rifling grooves
(C) The ejector
(D) The breech block

21. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Rifling in the barrel of a firearm increases the accuracy and range of the projectile.
Reason (R): Rifling imparts a gyroscopic spin to the bullet, which stabilizes its flight and prevents it from tumbling.
In light of the above statements, choose the correct option:
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

22. In the context of a rifled barrel, how are the "lands" defined?
(A) The spiraling depressed channels cut into the interior surface of the barrel
(B) The specific microscopic firing pin marks left on the cartridge base
(C) The mechanical components used to extract and eject the spent cartridge
(D) The raised portions of the interior barrel surface

23. What does the term "magazine" refer to in firearms terminology?
(A) The primary explosive chemical compound contained inside the primer cap
(B) A device that stores ammunition and feeds it into the action
(C) The heavy internal component that directly strikes the firing pin
(D) The rear structural portion of the wooden stock resting on the shoulder

NODIA

24. What is the primary purpose of firearm sights (iron sights, telescopic sights)?
(A) To significantly increase the initial muzzle velocity of the projectile
(B) To safely extract and eject the spent cartridge case after firing
(C) To align the firearm's bore with the target
(D) To muffle and silence the noise generated by rapidly expanding gases

25. Which of the following defines the "twist" of rifling in a barrel?
(A) The physical depth of the spiral grooves cut into the firearm barrel
(B) The total structural mass and overall weight of the bullet being fired
(C) The internal diameter of the barrel measured from land to opposite land
(D) The direction in which the grooves turn

26. In internal ballistics, what does the "pitch" of rifling signify?
(A) The barrel length required for the bullet to complete one full rotation
(B) The overall physical length of the barrel measured from breech face to muzzle
(C) The specific chemical formulation of the

or cancel a standard civilian license for a Non-Prohibited Bore (NPB) firearm?
(A) The District Magistrate (DM)
(B) The Superintendent of Police (SP)
(C) The Director of the State Forensic Science Laboratory
(D) The Chief Judicial Magistrate (CJM)

79. Section 3 of the Arms Act, 1959, explicitly prohibits which of the following activities without a valid license?
(A) Transporting toy guns or replica firearms across state borders
(B) The open carrying of simple wooden batons by security personnel
(C) Acquisition and possession of firearms and ammunition
(D) The regular use of target air rifles in recognized sports events

80. Consider the following statements concerning ammunition propellants:
I. Black powder burns by the process of deflagration rather than detonation.
II. Smokeless powder generates significantly higher chamber pressures than black powder.
III. Black powder leaves a heavy, corrosive solid residue in the barrel after firing.
Which of the above statements is/are correct?
(A) I and II only
(B) I and III only
(C) II and III only
(D) I, II, and III

81. In specialized ballistic applications, what is a "sabot"?
(A) A chemical additive blended into propellant to minimize visible muzzle flash.
(B) The solid metal jacket completely enclosing the lead core of a handgun bullet.
(C) A lightweight carrier for a sub-calibre bullet, discarded upon exit.
(D) A heavy iron slug used specifically for breaching reinforced security doors.

82. What is the primary characteristic and purpose of a "frangible" bullet?
(A) It is designed to penetrate heavy hardened steel armor plating effortlessly.
(B) It breaks into tiny particles on hard impact to prevent ricochet.
(C) It is designed to leave a distinct visible trail of smoke to track flight.
(D) It expands in a controlled mushroom shape within soft tissue for hunting game.

83. A cartridge that contains a primer and a propellant charge, but lacks a projectile, is legally and technically known as a:
(A) Dummy cartridge
(B) Squib cartridge
(C) Tracer cartridge
(D) Blank cartridge

84. "Dum-Dum" bullets are fundamentally an early example of which class of ammunition?
(A) Expanding bullets
(B) Armour-piercing hard core bullets
(C) Full metal jacketed rifle bullets
(D) Frangible target projectiles

85. In forensic pathology and ballistics, what causes a "tandem bullet" scenario?
(A) A shotgun firing two heavy solid lead slugs simultaneously from double barrels.
(B) A shooter discharging two distinct handguns at the exact same fraction of a second.
(C) A second fired bullet strikes and pushes out a bullet lodged from a squib load.
(D) A bullet that shatters completely into two equal structural halves before impact.

86. The speed at which a projectile travels at the exact instant it clears the forward end of the firearm's barrel is defined as:
(A) Muzzle velocity
(B) Terminal velocity
(C) Striking velocity
(D) Rotational velocity

87. In external ballistics, what does the "ballistic coefficient" of a bullet measure?
(A) The total chemical explosive energy contained within the primer cup
(B) The numerical ratio of bullet mass to the total weight of propellant
(C) The physical degree to which a bullet expands upon hitting soft tissue
(D) The projectile's ability to overcome air resistance in flight

88. The curved path that a projectile follows through the air from the moment it leaves the muzzle until it impacts the target is called its:
(A) Line of sight
(B) Trajectory
(C) Ricochet arc
(D) Nutation path

Click Here to Buy book on Flipkart

3. Initiator (Primary explosive)
4. Fuel

(A) P-3, Q-1, R-4, S-2
(B) P-1, Q-3, R-2, S-4
(C) P-4, Q-2, R-1, S-3
(D) P-3, Q-4, R-1, S-2

35. What is the traditional proportional composition by weight of standard black powder used in firearms?
(A) 75% Potassium nitrate, 15% Charcoal, 10% Sulphur
(B) 50% Potassium nitrate, 30% Charcoal, 20% Sulphur
(C) 60% Potassium nitrate, 20% Charcoal, 20% Sulphur
(D) 85% Potassium nitrate, 10% Charcoal, 5% Sulphur

36. Which of the following chemical substances constitutes the active energetic base of a "single-base" smokeless powder?
(A) Nitroglycerin
(B) Nitroguanidine
(C) Nitrocellulose
(D) Ammonium nitrate

37. A "double-base" smokeless powder used in ammunition is primarily manufactured from a combination of which two compounds?
(A) Nitrocellulose and Nitroglycerin
(B) Nitrocellulose and Potassium nitrate
(C) Nitroglycerin and Trinitrotoluene (TNT)
(D) Nitrocellulose and Nitroguanidine

38. To reduce barrel wear and muzzle flash in high-performance artillery and rifle ammunition, a "triple-base" powder is used. What is the third major active component added to nitrocellulose and nitroglycerin in triple-base powder?
(A) Lead azide
(B) Barium peroxide
(C) Sodium bicarbonate
(D) Nitroguanidine

39. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Smokeless powder generates significantly less visible smoke upon discharge compared to black powder.
Reason (R): Smokeless powder deflagrates to produce almost entirely gaseous products, leaving very little solid residue.
In light of the above statements, choose the correct option:
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

40. In ammunition terminology, what does "FMJ" stand for, and what characterizes this bullet type?
(A) Fragmenting Metal Jacket; a fragile bullet designed to shatter immediately upon leaving the muzzle velocity zone.
(B) Full Muzzle Jolt; a high-pressure proof testing cartridge loaded specifically to test action strength.
(C) Full Metal Jacket; a lead core enclosed in a hard metal shell.
(D) Flat Metal Jacket; a target bullet designed exclusively with a flat tip for cutting clean holes in paper targets.

41. What is the intended terminal ballistic behavior of a soft-point or hollow-point bullet upon striking soft tissue?
(A) To pass clean through the target tissue with minimal energy transfer or disruption
(B) To completely disintegrate into fine metal dust prior to entering the target
(C) To alter its flight trajectory by exactly ninety degrees immediately upon target impact
(D) To expand rapidly upon impact, transferring kinetic energy

42. A specialized bullet designed to penetrate hardened steel or bulletproof vests typically contains a rigid inner core made of which material?
(A) Hardened steel or tungsten carbide
(B) Soft cast lead alloy mixture
(C) Pure solid annealed copper
(D) High-density compressed plastic polymer

43. Which type of special-purpose bullet contains a pyrotechnic composition in its base that ignites upon firing to leave a bright visible path in flight?
(A) Armour-piercing bullet
(B) Tracer bullet
(C) Frangible bullet
(D) Dum-Dum bullet

Downloaded from www.pdf.tube

44. In shotgun ammunition, what is the collective term for the multiple small, spherical lead or steel projectiles loaded into the shell?
(A) Slugs
(B) Shot
(C) Wads
(D) Sabots

45. What is the primary function of the "wad" in a standard shotgun shell?
(A) To seal propellant gases and separate them from the shot column
(B) To reliably ignite the main smokeless powder propellant charge inside the shell
(C) To impart a rapid stabilizing gyroscopic spin to individual shotgun pellets
(D) To automatically eject the spent shell casing from the firearm chamber after firing

46. What is a "slug" in the context of shotgun ammunition?
(A) A specialized chemical compound used in non-corrosive primer mixes
(B) The reinforced metallic base structure of a modern shotgun shell
(C) A single large solid projectile fired from a shotgun
(D) A centerfire cartridge that completely fails to ignite upon firing

47. Consider the following statements regarding cartridge cases and headstamps:
I. Headstamp markings are found on the base of the cartridge case and indicate the calibre and manufacturer.
II. A rimless cartridge case has an extractor groove machined into its base.
III. The cartridge case expands upon firing to seal the chamber and prevent rearward gas escape.
IV. Brass is never used for modern cartridge cases due to its tendency to rust.
Which of the above statements are correct?
(A) I, II, and III only
(B) II, III, and IV only
(C) I, III, and IV only
(D) I, II, and IV only

48. In ammunition terminology, what is a "misfire"?
(A) A mechanical hazard where the bullet lodges halfway down the barrel during discharge
(B) A perceptible time delay between the striking of the primer and powder ignition
(C) The unexpected accidental discharge of a loaded firearm when dropped on a surface
(D) Complete failure of a cartridge to fire when struck

49. When the firing pin strikes the primer, but there is a noticeable delay of a fraction of a second or more before the gun discharges, this phenomenon is called a:
(A) Squib load
(B) Misfire
(C) Hangfire
(D) Ricochet

50. A "squib load" is a dangerous ammunition malfunction. Which of the following best defines a squib load?
(A) An overcharged cartridge containing excessive propellant, causing immediate barrel failure.
(B) A weak charge or failure that leaves the bullet stuck inside the barrel.
(C) A structural failure causing the bullet to shatter into fragments upon exiting the muzzle.
(D) A mechanical failure causing the weapon to discharge automatically without stopping.

NODIA

51. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Firing a subsequent shot immediately after experiencing a squib load is extremely hazardous to the shooter.
Reason (R): The bullet lodged in the barrel acts as an obstruction, and the pressure from the second shot can cause the barrel to bulge or catastrophically burst.
In light of the above statements, choose the correct option:
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

52. What is the fundamental safety rule when receiving a firearm in the laboratory for forensic examination?
(A) Treat the firearm as loaded until cleared in a safe direction.
(B) Assume the submitted firearm is completely unloaded whenever it is in an evidence bag.
(C) Test-fire the submitted evidence weapon

immediately to evaluate basic operational function.
(D) Look directly down the open muzzle end to inspect internal rifling conditions right away.

53. Which of the following legal statutes in India primarily governs the licensing, possession, and classification of firearms and ammunition?
(A) The Bharatiya Nyaya Sanhita, 2023
(B) The Explosive Substances Act, 1908
(C) The Arms Act, 1959
(D) The Bharatiya Nagarik Suraksha Sanhita, 2023

54. Under the Indian legal classification of firearms, which of the following calibres is universally classified as a "Prohibited Bore" (PB) weapon for civilian use?
(A) 9mm pistol
(B) .32 inch revolver or pistol
(C) .22 inch target bolt-action rifle
(D) .315 inch sporting bolt-action rifle

55. Which of the following represents a "Non-Prohibited Bore" (NPB) firearm, for which a standard civilian arms license can be issued in India?
(A) 7.62mm self-loading rifle
(B) 9mm submachine gun
(C) .303 inch rifle
(D) .32 inch revolver

56. Consider the following statements regarding definitions under the Arms Act, 1959:
I. "Arms" includes articles designed solely for domestic or agricultural uses such as ordinary walking sticks and agricultural tools.
II. "Ammunition" includes rockets, bombs, grenades, and other missiles.
III. "Prohibited arms" means firearms so designed that, if pressure is applied to the trigger, missiles continue to be discharged until pressure is removed from the trigger or the magazine is empty.
Which of the above statements is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

57. Match the firearm action types in List I with their characteristic descriptions in List II.
List I: Action Type
P. Pump-action
Q. Bolt-action
R. Lever-action
S. Break-action
List II: Description
1. The barrel(s) hinge downward to expose the breech for loading and unloading.
2. A sliding fore-end is moved back and forth to eject the spent shell and load a new one.
3. A handle operated by a lever around the trigger guard is cycled to load a fresh cartridge.
4. A handle is lifted and pulled rearward manually to open the breech and extract the case.
(A) P-2, Q-4, R-3, S-1
(B) P-4, Q-2, R-1, S-3
(C) P-2, Q-3, R-4, S-1
(D) P-1, Q-4, R-3, S-2

58. In internal ballistics, what is the meaning of "lock time"?
(A) The total time duration taken for a fired projectile to travel from muzzle to target
(B) The overall time required for a shooter to manually reload an empty firearm magazine
(C) The duration during which microscopic gunshot residue particles remain suspended in air
(D) The time from sear release to firing pin striking the primer

59. Which of the following shotgun chamberings is an exception to the traditional gauge measurement system, being named instead by its approximate actual bore diameter in inches?
(A) .410 Bore
(B) 12 Bore
(C) 20 Bore
(D) 10 Bore

60. Modern confirmatory tests for Gunshot Residue (GSR) typically screen for the presence of three specific elements originating from the primer mixture. What are these three elements?
(A) Copper, Zinc, and Nickel
(B) Lead, Barium, and Antimony
(C) Potassium, Sulfur, and Carbon
(D) Iron, Magnesium, and Tungsten

61. Given below is a list of steps for a forensic scientist handling a firearm received as evidence:
1. Document and photograph the firearm in its "as received" condition.

Click Here to Buy book on Amazon

a standard self-loading pistol exclusively fires bottlenecked rifle cartridges.
(C) A revolver features a rotating multi-chambered cylinder, whereas a standard pistol has its chamber integral to the barrel.
(D) A revolver is constructed with a completely smooth bore, whereas a standard pistol always possesses a fully rifled bore.

9. In a single-action revolver, what must the shooter do before every shot can be fired?
(A) Pull the slide backward to chamber a new round
(B) Pump the fore-end backwards and forwards
(C) Rotate the cylinder manually using the non-firing hand
(D) Manually cock the hammer, which also rotates the cylinder

10. How does a typical semi-automatic pistol function after the first round is fired?
(A) Energy from the fired round cycles the action, ejects the spent case, and chambers a new cartridge.
(B) The shooter must manually operate a bolt handle to extract the fired case and load the next cartridge.
(C) The shooter must manually cock the hammer after each shot to advance the round from a rotary magazine.
(D) The mechanism continues to discharge projectiles automatically for as long as the trigger remains held down.

11. Consider the following statements regarding improvised or country-made firearms:
I. They are frequently constructed from substandard materials such as water pipes and steering columns.
II. They typically exhibit standardized and high-quality rifling identical to factory-made weapons.
III. They pose a significant safety risk of barrel explosion due to their inability to withstand standard firing pressures.
Which of the above statements is/are correct?
(A) I and II only
(B) I and III only
(C) II and III only
(D) I, II, and III

12. What is the primary characteristic that distinguishes a standard assault rifle from a submachine gun (SMG)?
(A) A rifle fires standard pistol-calibre ammunition, whereas an SMG fires intermediate or full-power rifle cartridges.
(B) A rifle fires full-power or intermediate cartridges, whereas an SMG fires pistol-calibre ammunition.
(C) A rifle utilizes a completely smooth internal bore, whereas an SMG utilizes a fully rifled internal bore.
(D) A rifle relies on a bolt-action mechanism, whereas an SMG relies on a pump-action operating mechanism.

13. Which of the following best describes a typical shotgun?
(A) A smooth bore shoulder firearm designed to fire multiple lead pellets or a single slug.
(B) A rifled shoulder firearm designed to fire single heavy metallic slugs over long distances.
(C) A short-barreled handgun designed to fire high-velocity bottleneck cartridges.
(D) A fully automatic firearm designed for suppressive fire using pistol-calibre ammunition.

14. In a firearm, what is the primary function of the breech mechanism?
(A) To impart a rapid stabilizing spinning motion to the expelled projectile
(B) To significantly reduce the perceived recoil energy felt by the shooter
(C) To securely seal the rear of the barrel prior to firing
(D) To automatically eject the spent cartridge casing away from the firearm

15. What is the primary propellant mechanism used in forensic-interest airguns?
(A) Rapid deflagration of finely ground black powder
(B) Instantaneous detonation of a percussion cap
(C) Deflagration of single-base smokeless powder
(D) Expansion of compressed air or gas

16. The metallic tube through which the projectile is directed and accelerated is known as the:
(A) Action
(B) Stock
(C) Barrel
(D) Receiver

NODIA

(A) I, II, and III only
(B) II, III, and IV only
(C) I, III, and IV only
(D) I, II, and IV only

70. In external ballistics, what is the definition of "yaw"?
(A) Deviation of the bullet's longitudinal axis from its line of flight
(B) The upward angle at which the gun barrel is elevated relative to the horizon before firing
(C) The rapid loss of kinetic energy experienced by the bullet upon impacting target tissue
(D) The radial expansion and mushrooming of the bullet within soft biological tissue

71. The small, cyclical, circular motion of the bullet's tip around its trajectory path in flight, resembling the wobble of a spinning top, is technically termed:
(A) Ricochet
(B) Deflagration
(C) Cannelure
(D) Nutation

72. A bullet strikes a solid brick wall at a shallow angle and bounds off the surface to strike a secondary target. This phenomenon is known as:
(A) Keyholing
(B) Ricochet
(C) Yawing
(D) Mushrooming

73. In a firearm, what is the "chamber"?
(A) The external detachable box-like structure that holds spare unfired ammunition
(B) The internal frame mechanism that houses the firing pin, sear, and mainspring
(C) The rear of the barrel or cylinder shaped to support the cartridge
(D) The hollow cavity located inside the tip of an expanding hollow-point bullet

74. Match the anatomical parts of a centerfire cartridge case in List I with their functions in List II.
List I: Anatomical Part
P. Primer pocket
Q. Flash hole
R. Extractor groove
S. Case mouth
List II: Function
1. Grips and holds the bullet in place
2. Houses the percussion cap
3. Allows the extractor claw to grip the base for removal
4. Vents the hot gases from the ignited primer to the propellant
(A) P-2, Q-4, R-3, S-1
(B) P-4, Q-2, R-1, S-3
(C) P-2, Q-3, R-4, S-1
(D) P-1, Q-4, R-2, S-3

75. Which of the following represents the correct procedural sequence when a suspect bullet recovered from a crime scene is examined forensically?
(A) Visual examination and documentation → Weighing → Calibre determination → Comparison microscopy with test-fired bullets
(B) Weighing → Comparison microscopy with test-fired bullets → Calibre determination → Visual examination and documentation
(C) Comparison microscopy with test-fired bullets → Calibre determination → Visual examination and documentation → Weighing
(D) Calibre determination → Visual examination and documentation → Comparison microscopy with test-fired bullets → Weighing

76. Why do standard double-action revolvers rarely leave extractor and ejector marks on cartridge cases at a crime scene, unlike semi-automatic pistols?
(A) Because revolvers completely lack an extractor claw or ejector rod mechanism.
(B) Fired cases remain in the cylinder until manually extracted.
(C) Because revolver cartridge cases are completely consumed by fire during discharge.
(D) Because spent cartridge cases are ejected forcefully forward out through the muzzle.

77. Which common shape of airgun pellet is characterized by a pinched waist and a hollow base, designed to expand slightly upon firing to engage the rifling?
(A) Round spherical ball
(B) Diabolo
(C) Flat-head wadcutter
(D) Sabot full slug

78. Under the Arms Act, 1959, which authority in a district is generally empowered to issue, renew,

Downloaded from www.pdf.tube

primary explosive used in the primer
(D) The acoustic frequency and sound level emitted when the firearm is discharged

27. Which of the following represents the correct chronological sequence of events when a loaded semi-automatic pistol is fired?
(A) Trigger pull → Hammer/striker release → Primer detonation → Propellant deflagration → Bullet expelled
(B) Trigger pull → Propellant deflagration → Primer detonation → Hammer/striker release → Bullet expelled
(C) Primer detonation → Trigger pull → Propellant deflagration → Hammer/striker release → Bullet expelled
(D) Trigger pull → Hammer/striker release → Propellant deflagration → Primer detonation → Bullet expelled

28. How is the "bore" of a rifled firearm typically measured?
(A) The internal distance measured from the bottom of one groove to the opposite groove
(B) The internal barrel diameter measured from one land to the opposite land
(C) The external structural circumference of the metallic barrel measured at the muzzle
(D) The overall physical length of the internal chamber where the cartridge rests

29. The term "gauge" is used to specify the size of shotgun barrels. On what physical principle is the gauge strictly based?
(A) The number of barrel-diameter lead spheres that equal one pound
(B) The precise internal diameter of the smooth barrel measured in millimeters
(C) The precise internal diameter of the smooth barrel in hundredths of an inch
(D) The maximum effective tactical range of the shotgun measured in meters

30. Consider the following statements concerning a "choke" in a shotgun barrel:
I. It is a partial constriction of the bore, usually at or near the muzzle.
II. It is designed to control the dispersion or spread of the shot pattern.
III. A "full choke" produces a wider shot spread at a short distance compared to a "cylinder bore".
Which of the above statements is/are correct?
(A) I and II only
(B) I and III only
(C) II and III only
(D) I, II, and III

31. Which of the following correctly distinguishes a centerfire cartridge from a rimfire cartridge?
(A) A rimfire cartridge uses black powder propellant exclusively, whereas a centerfire cartridge utilizes modern smokeless powder formulations.
(B) A centerfire cartridge completely lacks a metallic cartridge case, whereas a rimfire cartridge always utilizes a heavy brass case.
(C) A centerfire cartridge is designed strictly for low-power airguns, whereas a rimfire cartridge is used exclusively in high-power rifles.
(D) A rimfire has primer mix in the rim, while centerfire has a central primer cup.

32. What is the fundamental difference between a Boxer primer and a Berdan primer?
(A) A Boxer primer contains black powder composition, while a Berdan primer contains advanced smokeless propellant compounds.
(B) A Boxer primer is used exclusively in rimfire ammunition, while a Berdan primer is restricted entirely to centerfire ammunition.
(C) A Boxer primer has an internal anvil, whereas a Berdan anvil is part of the case.
(D) A Boxer primer contains multiple ignition flash holes, while a Berdan primer contains only a single central flash hole.

33. When examining a fired cartridge case with a Berdan primer system, how many flash holes will typically be observed in the primer pocket?
(A) One central flash hole
(B) Two or sometimes three off-center flash holes
(C) Four distinct flash holes arranged in a square
(D) No flash holes are present in a Berdan system

34. Match the chemical components of a standard primer mixture in List I with their primary function in List II.
List I: Chemical Component
P. Lead styphnate
Q. Barium nitrate
R. Antimony sulfide
S. Tetracene
List II: Function
1. Oxidizer
2. Sensitizer

NODIA

89. When a bullet loses its gyroscopic stability in flight and tumbles, it may strike the target sideways. The elongated, asymmetrical hole this produces in the target is known forensically as:
(A) Mushrooming
(B) Spalling
(C) Keyholing
(D) Obturation

90. The term "drop" in external ballistics refers to the vertical distance a projectile falls due to which fundamental force?
(A) Air resistance
(B) The Coriolis effect
(C) Gyroscopic drift
(D) Gravity

www.nodia.in

Click Here to Buy book on Flipkart

ejectors to forcefully throw empty casings from the firearm after each shot, revolver casings remain stored inside cylinder chambers until manually extracted by the user, leaving no ejected cases at scenes.

77. (B) Diabolo
The diabolo design is the most ubiquitous pellet shape used in modern airguns. Featuring an hourglass profile with a solid nose, narrow waist, and flared hollow skirt base, this aerodynamic structure expands slightly upon firing gas pressure to grip barrel rifling, ensuring optimal gas seal and gyroscopic rotational stability during pellet flight.

78. (A) The District Magistrate (DM)
Under the legal administrative provisions of the Indian Arms Act of 1959, the District Magistrate, acting as the primary licensing authority within a district, holds statutory power to grant, renew, suspend, or revoke standard civilian arms licenses for Non-Prohibited Bore firearms, following thorough police background investigations and verification of security necessity.

79. (C) Acquisition and possession of firearms and ammunition
Section 3 of the Arms Act, 1959, lays down a fundamental statutory prohibition, declaring that no person shall acquire, possess, or carry any firearm or ammunition unless holding a valid license issued by designated statutory authorities in accordance with statutory rules, establishing criminal penalties for unauthorized weapon possession across India.

80. (D) I, II, and III
Ammunition propellants exhibit distinct physical and chemical combustion properties during firearm discharge. Black powder burns through rapid deflagration rather than detonation, leaving a heavy, highly corrosive solid residue inside barrels. Modern smokeless powder generates significantly higher peak chamber gas pressures than black powder, requiring robust firearm metallurgy for safe weapon discharge.

81. (C) A lightweight carrier for a sub-calibre bullet, discarded upon exit.
A sabot is a lightweight plastic or metallic collar sleeve fitted around a sub-calibre projectile inside a larger bore barrel. The sabot seals expanding gas pressure during internal acceleration, allowing the lighter projectile to attain extremely high muzzle velocity. Upon exiting the muzzle, aerodynamic drag separates and discards the sabot from flight.

82. (B) It breaks into tiny particles on hard impact to prevent ricochet.
Frangible bullets are manufactured by compressing fine metallic powders, such as copper or tin, without full thermal sintering. Engineered to shatter into tiny harmless granules upon striking hard obstacles or metallic backstops, frangible projectiles eliminate hazardous ricochets and over-penetration risks, making them ideal for law enforcement training and close-quarters operations.

83. (D) Blank cartridge
A blank cartridge contains a functional primer and energetic propellant powder housed inside a metallic case, but lacks a bullet or solid missile projectile. Sealed with a star crimp or paper wad, blank cartridges generate loud explosive noise, flash, and gas pressure upon discharge, finding utility in military training, theatrical productions, and signaling.

84. (A) Expanding bullets
Dum-Dum bullets were developed historically at the British Dum Dum Arsenal near Kolkata, India. Designed by modifying standard full metal jacketed rifle projectiles to expose their soft lead core at the nose tip, these early expanding bullets flattened and expanded dramatically upon tissue impact, causing extensive wound disruption and severe kinetic energy transfer.

NODIA

85. (C) A second fired bullet strikes and pushes out a bullet lodged from a squib load.
A tandem bullet phenomenon occurs when a squib load leaves a bullet lodged within the barrel bore, followed immediately by the discharge of a subsequent live cartridge. The second fired bullet travels down the barrel, impacts the stationary lodged bullet from behind, and drives both projectiles out of the muzzle together in tandem alignment.

86. (A) Muzzle velocity
Muzzle velocity measures the linear speed at which a projectile travels at the precise moment it exits the forward end of the barrel muzzle. Determined by propellant charge weight, gas pressure, barrel length, and bullet mass, muzzle

9. (D) Manually cock the hammer, which also rotates the cylinder
Single-action revolvers require the shooter to manually pull back and cock the hammer before firing each round. This manual mechanical motion simultaneously rotates the multi-chambered cylinder to index a fresh cartridge into direct alignment with the barrel while setting the internal trigger mechanism. Pulling the trigger subsequently releases the hammer to strike the primer.

10. (A) Energy from the fired round cycles the action, ejects the spent case, and chambers a new cartridge.
Semi-automatic pistols utilize kinetic energy generated by expanding high-pressure propellant gases or physical recoil to automatically operate the mechanical slide assembly. This action extracts and ejects the spent cartridge casing, cocks the internal firing mechanism, and feeds a new cartridge from the spring-loaded magazine into the chamber, requiring a separate trigger pull per shot.

11. (B) I and III only
Country-made firearms are crudely fabricated, unstandardized weapons assembled from non-standard materials like steel pipes, water tubing, or metal rods. Lacking commercial proofing, precise rifling, or metallurgical quality control, these crude weapons frequently fail to withstand high chamber gas pressure during firing, creating severe structural hazards, barrel rupture, and personal safety risks to users.

12. (B) A rifle fires full-power or intermediate cartridges, whereas an SMG fires pistol-calibre ammunition.
Operational distinctions between assault rifles and submachine guns rest on ammunition characteristics. Assault rifles chamber full-power or intermediate rifle cartridges, delivering higher velocity, extended effective range, and enhanced barrier penetration. Submachine guns are compact automatic or selective-fire weapons designed specifically to fire lower-powered pistol-calibre cartridges, making them suitable primarily for close-quarters engagements.

13. (A) A smooth bore shoulder firearm designed to fire multiple lead pellets or a single slug.
Shotguns are long-barrelled shoulder firearms featuring a smooth inner bore, engineered to discharge shotshells filled with numerous lead or non-toxic metallic pellets. Alternatively, shotguns can fire single heavy solid metallic slugs. Due to their unrifled internal barrels, they excel at close-range applications, projecting a spreading cluster pattern of projectiles upon discharge.

14. (C) To securely seal the rear of the barrel prior to firing
The breech mechanism is a critical structural component of a firearm designed to securely lock and seal the rear opening of the barrel chamber during ignition. This tight mechanical containment safely withstands high internal gas pressure generated by burning propellant, directing all expanding forces forward to propel the projectile through the muzzle.

15. (D) Expansion of compressed air or gas
Airguns operate on pneumatic mechanical principles completely distinct from conventional firearms utilizing chemical propellants. They launch metallic pellets or steel BBs through sudden expansion of pre-compressed atmospheric air or stored gases, such as carbon dioxide. Compression is achieved using manual spring-piston assemblies, pneumatic pump levers, or pre-charged pneumatic high-pressure gas reservoirs.

NODIA

16. (C) Barrel
The barrel is a central tubular metallic component of a firearm through which expanding propellant gases accelerate the projectile toward the muzzle. Its precision-engineered internal bore guides the direction of flight, contains extreme combustion pressures, and, in rifled systems, imparts spin to ensure aerodynamic stability and trajectory accuracy during external ballistic movement.

17. (B) The firing pin
The firing pin is a critical internal firing mechanism component designed to deliver a rapid mechanical impact against the primary explosive mixture housed within the cartridge primer cup. This striking action compresses the sensitive chemical compound against an internal or external anvil, initiating friction-induced detonation that subsequently ignites the main powder charge.

18. (C) I, II, and IV only
In firearm mechanical operations, the extractor grips and draws the spent cartridge case out of the chamber, while the ejector forcefully expels

component alongside nitrocellulose and nitroglycerin. The inclusion of nitroguanidine substantially lowers overall flame temperature while maintaining explosive gas output. This thermal reduction minimizes barrel bore erosion and effectively dampens visible muzzle flash during high-velocity military rifle and artillery discharge operations.

39. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Black powder combustion yields roughly fifty-five percent unburned solid particulate matter, producing dense clouds of smoke upon firing. In contrast, modern smokeless powders undergo complete energetic deflagration, converting almost entirely into gaseous products such as carbon dioxide, water vapor, and nitrogen, leaving minimal solid residue and generating virtually no smoke.

40. (C) Full Metal Jacket; a lead core enclosed in a hard metal shell.
Full Metal Jacket bullet construction features a dense central core, usually made of soft lead alloy, completely enclosed within an outer metallic shell of gilding metal, cupronickel, or brass. This hard outer jacketing prevents barrel lead fouling, ensures reliable action feeding in semi-automatic firearms, and minimizes bullet deformation during target penetration.

41. (D) To expand rapidly upon impact, transferring kinetic energy
Soft-point and hollow-point bullets are specialized expanding projectiles engineered with exposed lead tips or nose cavities. Upon striking soft biological tissue, fluid hydraulic pressure causes the front nose section to peel back and expand into a characteristic mushroom shape, rapidly transferring kinetic energy, creating wider wound channels, and limiting deep over-penetration.

42. (A) Hardened steel or tungsten carbide
Armour-piercing bullets are specifically engineered to defeat hardened structural targets, body armor, and metallic barriers. They incorporate a high-density, ultra-hard core constructed from materials such as heat-treated tool steel, hardened alloy, or tungsten carbide. Encased in a softer jacket, the rigid inner penetrator maintains integrity, punching directly through protective armor.

43. (B) Tracer bullet
Tracer bullets contain a slow-burning pyrotechnic chemical mixture packed into a cavity situated at the base of the projectile. Upon firing, high-temperature propellant gases ignite this compound, creating a bright, visible light streak along the trajectory path. This permits shooters to visually track bullet flight and adjust aim during low-light conditions.

44. (B) Shot
In shotgun terminology, the collective assembly of small spherical metal projectiles contained within a single shotshell is termed shot. Typically manufactured from lead alloy, steel, bismuth, or tungsten, these multiple pellets separate upon exiting the barrel muzzle, dispersing outward to form a expanding pattern designed for hunting game or target shooting applications.

45. (A) To seal propellant gases and separate them from the shot column
Shotgun wads serve several vital internal ballistic functions within modern shotshells. Positioned directly between the powder charge and shot pellets, the wad creates an airtight gas seal along smooth barrel walls upon propellant ignition, preventing expanding gas blow-by while physically shielding lead pellets from melting or deformation in the bore.

46. (C) A single large solid projectile fired from a shotgun
A shotgun slug is a large, heavy single projectile designed to be discharged from smoothbore or specialized rifled shotgun barrels. Unlike conventional shot cartridges containing hundreds of tiny pellets, a single slug delivers concentrated kinetic energy and penetration over extended distances, rendering shotguns effective for big game hunting or breaching.

47. (A) I, II, and III only
Headstamp markings stamped onto cartridge bases identify key manufacturing origin and calibre specifications. Rimless cases feature an annular extractor groove machined near the base for mechanical extraction. Metallic cartridge cases expand radially under peak firing pressure, obturating the chamber to block rearward gas flow. Brass remains widely used due to malleability.

Downloaded from www.pdf.tube

such as point-three-zero or nine millimeter. Groove diameter, which is measured across opposite cut channels, is slightly wider to permit complete projectile engagement and effective gas sealing upon expansion.

29. (A) The number of barrel-diameter lead spheres that equal one pound
Shotgun gauge measurement originates from an ancient historical system based on weight. It defines the total number of identical solid lead spheres, each matching the internal diameter of the shotgun barrel, that collectively weigh exactly one avoirdupois pound. Consequently, smaller numerical gauge designations correspond directly to larger internal barrel bore diameters.

30. (A) I and II only
Shotgun chokes consist of deliberate internal bore constrictions situated near the muzzle. Designed to manage pellet cluster dispersion, a choke controls the spread rate and pattern density of shot pellets during external flight. A full choke creates tighter, more concentrated pellet groupings over distance, whereas unchoked cylinder bores yield wider dispersion patterns.

31. (D) A rimfire has primer mix in the rim, while centerfire has a central primer cup.
Ignition architecture distinguishes rimfire from centerfire cartridges. Rimfire cartridges press primary explosive impact mixture around the circumferential hollow interior of the base rim, which is directly crushed by the firing pin. Centerfire cartridges feature a separate, removable metallic primer cup seated centrally within a dedicated pocket located on the cartridge head.

32. (C) A Boxer primer has an internal anvil, whereas a Berdan anvil is part of the case.
Structural construction differentiates Boxer and Berdan centerfire primer systems. Boxer primers integrate an internal metallic anvil directly inside the removable primer cup itself, firing through a single large central flash hole. Conversely, Berdan primers lack an internal anvil; the anvil projection is formed as an integral part of the cartridge pocket.

33. (B) Two or sometimes three off-center flash holes
Berdan primed cartridge cases incorporate a built-in central metallic anvil inside the base pocket. Because this central projection blocks the middle of the pocket floor, hot ignition flames from the detonating primer mixture must pass into the propellant cavity through two, or occasionally three, small symmetrically positioned off-center flash vent holes.

34. (A) P-3, Q-1, R-4, S-2
Standard primary percussion primer mixtures integrate specialized functional chemical compounds. Lead styphnate functions as the primary explosive initiator triggered by mechanical shock. Barium nitrate provides necessary oxygen as an oxidizer. Antimony sulfide acts as a fuel source, while tetracene serves as a sensitizer to increase overall friction and shock sensitivity.

35. (A) 75% Potassium nitrate, 15% Charcoal, 10% Sulphur
Standard black powder represents a mechanical mixture formulated in precise empirical proportions by weight. The classic composition consists of seventy-five percent potassium nitrate serving as the inorganic oxidizer, fifteen percent charcoal providing organic carbon fuel, and ten percent sulfur acting as a chemical stabilizer and reducing ignition temperature for deflagration.

NODIA

36. (C) Nitrocellulose
Single-base smokeless propellants contain nitrated organic cellulose material, commonly known as nitrocellulose, as their sole primary active energetic compound. Produced by treating refined cotton fibers or wood pulp with nitric and sulfuric acids, nitrocellulose deflagrates rapidly when ignited, converting almost completely into high-pressure gaseous combustion products with minimal solid residue left behind.

37. (A) Nitrocellulose and Nitroglycerin
Double-base smokeless powders are manufactured by combining two main energetic chemical ingredients, namely nitrocellulose and liquid nitroglycerin. The incorporation of nitroglycerin gelatinizes the nitrocellulose structure, significantly increasing overall chemical energy density, flame temperature, and gas volume to produce elevated chamber pressures and higher projectile velocities during typical firearm firing operations.

38. (D) Nitroguanidine
Triple-base smokeless powders incorporate nitroguanidine as a third major energetic

handle rearward. Lever-action firearms cycle through a trigger-guard lever, while break-action shotguns hinge the barrel open to expose the breech.

58. (D) The time from sear release to firing pin striking the primer
Lock time represents a critical internal ballistics parameter defining the mechanical time interval elapsed between trigger sear disengagement and the moment the firing pin impacts the primer. Shorter lock times reduce the window for shooter movement or muscular tremor, thereby minimizing unwanted barrel movement before ignition and improving shot placement accuracy.

59. (A) .410 Bore
Unlike traditional shotguns whose sizes are derived from the lead-sphere pound weight ratio gauge system, the point-four-one-zero bore represents a prominent physical exception. It is named directly after its true internal barrel bore diameter, which measures approximately point-four-one-zero inches, making it a linear fractional inch measurement rather than a gauge calculation.

60. (B) Lead, Barium, and Antimony
Standard forensic identification of gunshot residue relies on discovering characteristic metallic elements produced during primary primer detonation. Modern primer caps contain lead styphnate as an initiator, barium nitrate as an oxidizer, and antimony sulfide as fuel. Detecting characteristic spherical particles containing lead, barium, and antimony provides definitive chemical proof of firearm discharge.

61. (B) 2, 1, 3, 4
Forensic handling of evidence firearms mandates strict protocol ordering. The primary step involves clearing the weapon in a safe direction to ensure it is completely unloaded. Next, the examiner logs and photographs the firearm in its as-received state. Subsequently, non-destructive surface recovery of biological DNA or latent prints occurs prior to physical disassembly.

62. (A) Moulded plastic
In contemporary commercial shotgun shell manufacturing operations, producers construct one-piece shot wads primarily using injection-moulded plastic polymer materials. These modern plastic wads incorporate a rear gas-sealing cup, a crushable central shock-absorbing cushion section, and a forward shot cup encasing lead pellets, shielding them against barrel wall friction during firearm discharge.

63. (C) To hold the shot pellets and wads securely in the case
The crimp situated at the forward mouth of a plastic or paper shotgun hull folds and seals the casing mouth inward. Its mechanical purpose is to hold internal shot wads and lead pellets securely inside the shell body, preventing moisture entry or component spill while providing structural resistance required for initial powder pressure build-up.

64. (D) The distance from the closed breech face to the seating surface in the chamber
Headspace defines the critical firearm distance measured between the fully locked breech face and the corresponding seating shoulder or rim abutment within the chamber. Proper headspace ensures correct cartridge positioning upon chambering; excessive headspace risks dangerous case head separations, whereas insufficient headspace prevents complete firearm locking, leading to dangerous mechanical malfunctions.

65. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Improvised and country-made firearms present major safety risks due to crude manufacturing techniques and weak structural components. Built from salvaged metal tubing or water pipes, these unstandardized weapons lack proper metallurgical tensile strength and do not undergo industry proof-testing, causing them to rupture or explosively shatter under high internal chamber combustion pressures.

66. (B) 70% Copper and 30% Zinc
Cartridge brass represents the industry standard copper alloy utilized globally for manufacturing metallic cartridge cases. Standardized near seventy percent copper and thirty percent zinc, this specific alloy provides optimal tensile ductility and elasticity, enabling cases to expand radially under high chamber pressure for effective gas obturation before returning to original dimensions for easy extraction.

Click Here to Buy book on Amazon

48. (D) Complete failure of a cartridge to fire when struck
In ballistics terminology, a misfire describes a total failure of a loaded round to discharge after the firing pin strikes the primer. Misfires stem from defective primary explosive compositions, dampened propellant powders, broken firing pins, or insufficient strike mechanical energy, resulting in no ignition or combustion taking place inside the chamber.

49. (C) Hangfire
A hangfire is a dangerous ammunition malfunction characterized by a distinct, perceptible delay between the firing pin striking the primer and actual propellant ignition. Caused by deteriorating priming compounds, contaminated powder charges, or sluggish chemical reactions, hangfires require shooters to keep weapons pointed in a safe direction to avoid delayed discharge hazards.

50. (B) A weak charge or failure that leaves the bullet stuck inside the barrel.
A squib load occurs when an undercharged or defective cartridge lacks sufficient combustion force to propel the bullet completely out of the firearm barrel. The projectile lodges within the bore as an obstruction, created by missing propellant, wet powder, or primer-only ignition, presenting a major mechanical hazard if subsequent rounds are fired.

51. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Discharging a subsequent round immediately following a squib load creates extreme hazards. The bullet lodged in the barrel acts as an immovable mechanical obstruction. High-pressure propellant gases generated by the second shot become trapped behind the obstruction, causing extreme pressure spikes that bulge, crack, or catastrophically rupture the metal barrel structure.

52. (A) Treat the firearm as loaded until cleared in a safe direction.
The paramount firearm safety rule in forensic laboratories requires examiners to treat every submitted weapon as loaded until personally verified and cleared. Upon handling, the examiner must immediately point the muzzle toward a designated safe direction or bullet trap, open the action, inspect the chamber, and remove all live cartridges before proceeding.

53. (C) The Arms Act, 1959
In India, the primary statutory law governing the manufacturing, acquisition, possession, sale, import, export, and transport of firearms and ammunition is the Arms Act, 1959. This comprehensive statutory framework categorizes prohibited and non-prohibited bore weapons, establishing mandatory licensing procedures, regulatory oversight mechanisms, and specific criminal penalties for illegal firearm possession.

54. (A) 9mm pistol
Under Indian firearm regulations, standard nine-millimeter automatic pistols and military calibres are categorized as Prohibited Bore firearms. Licensing for Prohibited Bore weapons is strictly restricted to government forces and exceptional security personnel. Civilians are legally prohibited from possessing such weapons unless specifically authorized by the central government under strict statutory provisions.

55. (D) .32 inch revolver
Non-Prohibited Bore firearms represent arms categories permissible for civilian ownership and possession in India subject to valid licensing. Handguns chambered in point-three-two inch calibre revolvers or pistols are categorized as Non-Prohibited Bore. Citizens fulfilling legal statutory criteria, security necessity, and background checks can obtain licenses from designated authorities for self-defense.

NQDIA

56. (B) II and III only
Under the Indian Arms Act of 1959, statutory definitions explicitly encompass military ordinance like rockets, bombs, and grenades within the meaning of ammunition. Prohibited arms specifically denote automatic weapons that continuously discharge missiles when trigger pressure is maintained. Domestic tools, agricultural implements, and ordinary walking sticks are explicitly excluded from being classified as arms.

57. (A) P-2, Q-4, R-3, S-1
Mechanical repeating actions function through distinctive manual operations. Pump-action designs utilize a sliding fore-end moved linearly to extract spent shells and load fresh rounds. Bolt-action mechanisms lift and pull a manual

ANSWERS

1. (B) Internal, External, and Terminal ballistics
Forensic ballistics is scientifically categorized into three distinct operational branches based on the projectile's stage of movement. Internal ballistics examines events inside the firearm prior to bullet emergence. External ballistics analyzes the projectile's flight path through the atmosphere. Terminal ballistics evaluates the interaction, behavior, and physical damage produced when the projectile impacts a target.

2. (D) Internal ballistics
Internal ballistics covers all mechanical and chemical phenomena occurring within a firearm during discharge. This domain encompasses firing pin strike, primer detonation, propellant ignition, gas pressure generation, bullet movement down the bore, and engagement with barrel rifling. It continues until the projectile completely clears the muzzle, providing essential data regarding pressure curves and initial propulsion.

3. (A) The moment the projectile exits the muzzle of the firearm
External ballistics specifically studies the flight dynamics of a projectile through the atmosphere. This phase commences precisely as the bullet exits the firearm muzzle, separating from expanding gases. Throughout flight, external forces such as gravity, aerodynamic drag, crosswinds, and gyroscopic stability influence its parabolic trajectory until it reaches the intended target or surface.

4. (C) The behavior and effect of the projectile upon striking the target
Terminal ballistics investigates the physical interactions that occur when a high-velocity projectile strikes, penetrates, or passes through a target material. It encompasses bullet deformation, disintegration, energy transfer, temporary and permanent cavity formation in biological tissues, ricochet dynamics, and structural impact effects, serving as a vital subfield within forensic firearm identification and wound ballistics analysis.

5. (A) 2, 4, 1, 3
Firearm ignition systems evolved chronologically to enhance reliability and discharge efficiency. Matchlocks appeared in the fifteenth century using burning wicks. Wheellocks emerged in the early sixteenth century using rotating steel wheels against pyrite. Flintlocks developed in the seventeenth century using flint striking steel. Percussion cap systems arose in the early nineteenth century utilizing impact-sensitive mercury fulminate mixtures.

6. (A) P-2, Q-4, R-1, S-3
Reverend Alexander Forsyth invented percussion ignition in 1807, replacing spark-ignition mechanisms. Samuel Colt mass-produced revolving cylinder handguns with interchangeable parts, popularizing the modern revolver. Hiram Maxim designed the first fully automatic machine gun in 1884 using recoil energy. Richard Gatling patented a hand-cranked multi-barrel gun in 1861, laying groundwork for rapid-fire military ordnance development.

7. (B) A smooth bore firearm has a smooth internal barrel, while a rifled firearm has spiral grooves cut into its bore.
Smooth bore firearms feature a completely uniform, ungrooved internal barrel wall, typically seen in conventional shotguns designed to fire multiple lead pellets. Conversely, rifled firearms possess helical grooves and lands machined into the inner barrel lining. These spiral features engage the metallic projectile during discharge to impart gyroscopic rotational spin required for aerodynamic stability.

8. (C) A revolver features a rotating multi-chambered cylinder, whereas a standard pistol has its chamber integral to the barrel.
Revolvers are handguns equipped with a revolving cylinder containing several individual cartridge chambers that sequentially align with a single stationary barrel before discharge. In contrast, standard semi-automatic or single-shot pistols incorporate a chamber formed directly as an integral part of the barrel assembly itself, utilizing removable box magazines to supply successive cartridges.

Downloaded from www.pdf.tube

67. (D) Buckshot uses larger pellets for heavy game, while birdshot uses small pellets for fowl.
Shotgun ammunition pellets are classified primarily by physical dimensions and target intent. Buckshot cartridges contain larger, heavy lead or alloy spheres designed for big game hunting or defensive tactical applications. Birdshot loads contain hundreds of tiny metal pellets intended to form wide dispersion patterns for hunting fast-flying waterfowl, game birds, or clay targets.

68. (A) A groove into which the case mouth is crimped
A cannelure is an circumferential knurled or pressed ring groove indented around the cylindrical body of a bullet. It provides a secure recessed seating location into which the cartridge case mouth is mechanically crimped during manufacturing, preventing bullet seating displacement or recoil-induced setback inside magazines while providing a retention line for bullet lubricants.

69. (A) I, II, and III only
Class characteristics of rifled barrels include manufacturing specifications like land and groove counts, direction of twist, and bore dimensions. Microscopic striations left inside grooves during manufacturing and bullet transit constitute unique individual characteristics for forensic identification. Barrel calibre represents a general class characteristic rather than an individual feature of firearms.

70. (A) Deviation of the bullet's longitudinal axis from its line of flight
In external ballistics, yaw describes the angular deviation between the long axis of a spinning bullet and its actual direction of aerodynamic vector trajectory flight. Caused by wind shear, muzzle blast turbulence, or improper gyroscopic spin stability, severe yaw increases drag, decreases flight range, and leads to bullet instability or tumbling.

71. (D) Nutation
Nutation refers to the minor, fast cyclical circular movement or wobble executed by a bullet's tip around its primary precessional axis during atmospheric flight. Similar to the delicate wobbling motion of a spinning top, nutation dampens as gyroscopic stability stabilizes the bullet, ensuring aerodynamically streamlined movement along its parabolic trajectory.

72. (B) Ricochet
Ricochet occurs when a moving projectile strikes an intermediate hard surface, obstacle, or liquid barrier at an oblique shallow angle and deflects off into a new secondary trajectory path rather than penetrating. Ricochet impacts alter bullet energy, velocity, stability, deformation, and flight path, leaving crucial trace impact markings for forensic trajectory reconstruction.

NODIA

73. (C) The rear of the barrel or cylinder shaped to support the cartridge
In firearms mechanics, the chamber is the enlarged rear portion of the barrel bore or revolving cylinder machined to precisely match outer cartridge dimensions. The chamber securely supports the metallic cartridge case wall during firing, containing intense high-pressure combustion gas forces generated by burning propellant powder until the projectile departs.

74. (A) P-2, Q-4, R-3, S-1
Anatomical features of centerfire cartridge cases perform distinct functions. The primer pocket houses the percussion cap containing primary explosives. The flash hole vents ignited hot primer gases into the main powder cavity. The extractor groove allows the mechanical extractor claw to grip the casing base, while the case mouth firmly retains the projectile.

75. (A) Visual examination and documentation → Weighing → Calibre determination → Comparison microscopy with test-fired bullets
Forensic examination of recovered crime scene bullets follows a logical non-destructive procedural sequence. Scientists first conduct initial visual examination and photography to document physical condition. Next, mass is measured using precision balances, followed by calibre determination. Finally, comparison microscopy is performed against laboratory test-fired standards to analyze microscopic individual striations.

76. (B) Fired cases remain in the cylinder until manually extracted.
Standard revolvers contain fired cartridge cases within individual revolving cylinder chambers following discharge. Unlike semi-automatic pistols that employ mechanical extractors and

it through the ejection port. The trigger sear retains the hammer or striker until released by trigger action. However, magazines serve exclusively as ammunition storage devices, not chemical igniters.

19. (A) To withdraw the spent case from the chamber
An extractor is a hooked mechanical component fitted within the firearm slide or bolt mechanism. Its primary function is to engage the extractor groove or rim of a cartridge case, pulling the fired casing rearward out of the chamber during cycling so that the ejector can subsequently clear it from the firearm.

20. (C) The ejector
The ejector is a stationary projection or spring-loaded pin located within the receiver or slide mechanism of self-loading firearms. Once the extractor pulls the fired cartridge casing out of the barrel chamber, the base of the casing contacts the ejector, forcefully flipping and pitching the empty case out through the ejection window.

21. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Barrel rifling consists of helical lands and grooves that cut into the outer surface of a moving projectile, imparting rapid longitudinal rotation. This gyroscopic spinning action stabilizes the bullet against aerodynamic drag forces, preventing keyholing, pitching, or tumbling in flight, thereby significantly increasing firing accuracy, effective range, and overall trajectory predictability.

22. (D) The raised portions of the interior barrel surface
In rifled gun barrels, machining operations create alternate raised and depressed spiral sections along the internal bore surface. Lands represent the original raised internal surface areas remaining between cut grooves. As a soft metallic projectile travels through the barrel, these lands bite into its outer surface, directly imparting rotational motion.

23. (B) A device that stores ammunition and feeds it into the action
A magazine is an essential ammunition storage and feeding device used in repeating and self-loading firearms. It houses unfired cartridges under spring pressure, sequentially advancing each round into position so that the cycling bolt or slide mechanism can strip and feed it into the firing chamber during repeating weapon operations.

24. (C) To align the firearm's bore with the target
Firearm sights are optical or mechanical aiming indicators mounted on a weapon to assist the shooter in proper target alignment. By visually aligning front and rear iron sight posts or reticles within telescopic scopes, shooters visually project the barrel's central bore line toward the target to compensate for bullet drop and windage.

25. (D) The direction in which the grooves turn
The twist of barrel rifling specifically denotes the rotational direction in which spiral lands and grooves turn along the internal bore axis. Firearm manufacturers cut rifling grooves in either a right-hand clockwise or left-hand counter-clockwise orientation, establishing a key class characteristic that is highly useful in forensic firearm identification and bullet comparison analysis.

26. (A) The barrel length required for the bullet to complete one full rotation
The pitch of rifling defines the specific linear distance along the barrel interior required for the spiral lands and grooves to complete one full revolution. Often expressed as a ratio such as one turn in ten inches, this measurement dictates the spin rate imparted to the bullet, which is critical for flight stabilization.

27. (A) Trigger pull → Hammer/striker release → Primer detonation → Propellant deflagration → Bullet expelled
Discharge follows a strict mechanical and chemical sequence. Depressing the trigger trips the sear mechanism, releasing the mechanical hammer or striker. The released component strikes the primer, causing friction-sensitive impact detonation. Heat and hot flames pass through flash holes, initiating rapid propellant deflagration, creating high gas pressure that forces the bullet down the bore.

28. (B) The internal barrel diameter measured from one land to the opposite land
Bore diameter in rifled firearms is standardly measured between diametrically opposed raised lands prior to groove cutting. This dimension establishes nominal barrel calibre designations,

Click Here to Buy book on Flipkart

velocity establishes the initial kinetic energy and trajectory characteristics governing subsequent external ballistic movement.

87. (D) The projectile's ability to overcome air resistance in flight
The ballistic coefficient is a numerical index representing a projectile's capacity to overcome atmospheric air resistance during external ballistic flight. Derived from bullet mass, sectional density, diameter, and drag profile, higher ballistic coefficient values signify superior aerodynamic efficiency, resulting in flatter flight trajectories and reduced velocity decay over extended shooting distances.

88. (B) Trajectory
In external ballistics, trajectory defines the continuous curved spatial path traversed by a flying projectile from the exact instant it departs the muzzle until striking the target. Shaped primarily by initial muzzle velocity, launch angle, Earth's gravitational pull, and atmospheric aerodynamic drag, the resulting flight path forms an asymmetrical parabolic arc.

89. (C) Keyholing
Keyholing occurs when a bullet loses gyroscopic spin stability during flight and tumbles end-over-end, striking the target sideways or at an angle instead of nose-first. The resulting impact leaves an irregular, elongated aperture resembling a keyhole, signaling improper barrel rifling twist rates, undersized bullet diameters, or severe in-flight bullet instability.

90. (D) Gravity
In external ballistics, bullet drop refers specifically to the downward vertical displacement of a flying projectile away from its original line of bore projection. As soon as the bullet leaves the constraining barrel muzzle, Earth's gravitational force acts continuously upon its mass, accelerating it downward at nine-point-eight meters per second squared.

www.nodia.in

Downloaded from www.pdf.tube

(B) 1 to 3 yards
(C) 10 to 15 yards
(D) Beyond 25 yards

41. When estimating shotgun firing distance, a standard forensic rule of thumb states that the diameter of the pellet spread (in inches) is roughly equal to the firing distance (in yards) for a shotgun equipped with which type of choke?
(A) Full choke barrel restriction
(B) Modified choke barrel restriction
(C) Improved cylinder restriction
(D) Cylinder bore

42. Consider the following statements regarding the determination of the range of fire:
I. Hard contact wounds to the head often exhibit a stellate appearance.
II. Stippling cannot be washed off easily because the powder grains are embedded in the skin.
III. Singeing of body hair is a classic indicator of a distant gunshot wound.
IV. A grease ring is deposited by the bullet as it enters the skin or clothing.
Which combination of statements is correct?
(A) I, II and IV
(B) II, III and IV
(C) I, III and IV
(D) I and II

43. The foundational principle of firearm identification (forensic ballistics) relies on the premise that:
(A) All bullets of the same caliber will produce perfectly matching markings under examination.
(B) No two firearms produce identical microscopic markings.
(C) Cartridge cases remain completely unaffected by peak internal chamber pressures during firing.
(D) Rifling twist rates dynamically change and degrade with every successive shot fired.

44. Which of the following is considered a CLASS characteristic of a rifled firearm barrel?
(A) The unique microscopic striations transferred from the firearm breech face
(B) Number, width, and twist direction of lands and grooves
(C) The specific microscopic surface imperfections found on the firing pin tip
(D) The exact depth and pattern of individual ejector mechanism scratches

NODIA

45. Which of the following represents an INDIVIDUAL characteristic imparted to a fired bullet?
(A) Microscopic striations in land/groove impressions
(B) The nominal physical diameter of the fired bullet
(C) The overall grain weight of the fired bullet core
(D) The structural base design shape of the bullet (e.g., boat tail design)

46. Extractor marks on a fired cartridge case are typically found on the:
(A) Center of the primer cup
(B) Ogive section of bullet
(C) Extraction groove
(D) Neck of the cartridge case

47. Given below are two lists: Match List I with List II.
List I: (Chemical Reagents)
P. Modified Griess Reagent
Q. Sodium Rhodizonate
R. Diphenylamine
S. Harrison-Gilroy Reagent
List II: (GSR Components Detected)
1. Nitrates from unburnt smokeless powder
2. Nitrites from partially burnt powder
3. Heavy metals (Lead, Barium, Antimony)
4. Lead margins around a bullet hole
(A) P-2, Q-4, R-1, S-3
(B) P-1, Q-4, R-2, S-3
(C) P-2, Q-3, R-1, S-4
(D) P-1, Q-3, R-2, S-4

48. When examining a fired bullet, the marks left by the raised portions of the barrel's rifling are called:
(A) Groove impressions
(B) Breech marks
(C) Land impressions
(D) Skid marks

49. A forensic expert recovers a fired 9mm bullet from a crime scene. It displays 6 land impressions with a right-hand twist. This data is sufficient to:
(A) Definitively identify the specific individual weapon that fired it
(B) Determine class characteristics to narrow possible makes
(C) Positively identify the individual shooter who discharged the firearm

(D) Barrel length

11. The phase of external ballistics begins precisely at what point?
(A) When the firing pin strikes the primer cup
(B) When the bullet leaves the muzzle
(C) When peak chamber pressure is achieved inside
(D) When the bullet finally strikes the target

12. Consider the following statements regarding the forces acting on a projectile in flight:
I. Gravity exerts a constant downward force on the projectile.
II. Air resistance (drag) acts in the opposite direction to the projectile's motion.
III. The Magnus effect applies exclusively to smoothbore projectiles like shotgun slugs.
Which combination of statements is correct?
(A) I and II
(B) II and III
(C) I and III
(D) I, II and III

13. The vertical drop of a bullet during its trajectory in a vacuum is dependent entirely on:
(A) Gravity and time of flight
(B) The total mass and density of the bullet
(C) The aerodynamic ballistic coefficient
(D) The rifling twist rate of the barrel

14. In external ballistics, aerodynamic drag on a bullet traveling at supersonic speeds is generally proportional to the:
(A) Square root of its velocity
(B) Inverse of its velocity
(C) Square of its velocity
(D) Cube of its velocity

15. Arrange the following events of a standard bullet's trajectory in the correct chronological order from firing to impact on a distant target:
I. Bullet achieves maximum ordinate (peak height)
II. Bullet impacts the target
III. Bullet exits the muzzle and crosses the line of sight for the first time
IV. Bullet drops below the line of sight
(A) III, I, IV, II
(B) III, IV, I, II
(C) I, III, IV, II
(D) III, I, II, IV

16. The ballistic coefficient of a bullet is a mathematical measure of its:
(A) Ability to expand and mushroom upon target impact
(B) Internal kinetic energy generated inside the bore
(C) Ability to overcome air resistance
(D) Propellant burning efficiency inside the chamber

17. The straight line extending from the muzzle of the firearm along the axis of the bore before the trigger is pulled is termed the:
(A) Line of sight
(B) Line of elevation
(C) Line of departure
(D) Maximum ordinate

18. Consider the following statements regarding projectile motion anomalies:
I. Yaw is the angle between the longitudinal axis of the bullet and its trajectory path.
II. Precession is the circular motion of the bullet's nose around its center of gravity.
III. Nutation refers to the small oscillatory movements or "nodding" of the bullet's tip.
IV. Gyroscopic spin eliminates yaw completely immediately upon the bullet exiting the muzzle.
Which combination of statements is correct?
(A) I, II and IV
(B) II, III and IV
(C) I, II and III
(D) I and III

19. The gyroscopic stability of a spin-stabilized bullet prevents it from tumbling end-over-end. This stabilization is determined by the:
(A) Twist rate of the barrel
(B) Sectional density of the projectile
(C) Total weight of the propellant charge
(D) Overall shape of the cartridge case

20. The drift of a spinning bullet caused by a crosswind is compounded by an aerodynamic phenomenon known as:
(A) The Coriolis effect
(B) The Doppler effect
(C) The Magnus effect
(D) The Venturi effect

21. A ricochet is most likely to occur when the angle of incidence between the bullet's flight path and a hard, flat surface is:
(A) Very small or acute
(B) 90 degrees (perpendicular)

Click Here to Buy book on Amazon

CHAPTER 28
Internal, External and Terminal Ballistics

1. The branch of forensic science that studies the motion of a projectile while it is still inside the barrel of the firearm is known as:
(A) Terminal ballistics
(B) Internal ballistics
(C) External ballistics
(D) Intermediate ballistics

2. What is the primary function of the primer in a centerfire cartridge?
(A) To seal the breech during firing
(B) To provide the main propulsive force for the bullet
(C) To lubricate the bullet as it enters the barrel
(D) To ignite the main propellant charge

3. Which of the following chemical compounds is most commonly used as the primary explosive initiator in modern non-corrosive primer mixtures?
(A) Lead styphnate
(B) Potassium nitrate
(C) Mercury fulminate
(D) Sodium azide

4. During the combustion of the propellant in a standard rifle cartridge, the peak chamber pressure generated typically falls into which range?
(A) 1,000 to 5,000 psi
(B) 10,000 to 20,000 psi
(C) 40,000 to 65,000 psi
(D) 100,000 to 150,000 psi

5. The process by which a bullet is forced into the rifling of the barrel, causing the jacket or lead to deform and take on the shape of the lands and grooves, is called:
(A) Engraving
(B) Obturation
(C) Precession
(D) Chambering

6. In internal ballistics, "barrel time" is accurately defined as the time elapsed from the:
(A) Trigger squeeze to the firing pin striking primer
(B) Ignition of primer to reaching peak chamber pressure
(C) Bullet exit from muzzle to impact on target
(D) Primer strike to bullet exit from the muzzle

7. The theoretical recoil velocity of a firearm can be calculated primarily using which fundamental principle of physics?
(A) Conservation of angular momentum
(B) Conservation of linear momentum
(C) Newton's first law of inertia
(D) Bernoulli's principle

8. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): A heavier rifle will produce less felt recoil than a lighter rifle when both are firing identical cartridges.
Reason (R): According to the law of conservation of momentum, the recoil velocity of a firearm is inversely proportional to its mass.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

9. Barrel vibration and harmonics generated during the internal ballistic phase primarily affect which aspect of the firearm's performance?
(A) The peak chamber pressure generated during firing
(B) The extraction velocity of the fired cartridge case
(C) The overall burning rate of the propellant charge
(D) The consistency of the point of impact

10. Which of the following factors does NOT significantly affect the internal ballistics of a firearm?
(A) Crosswind speed
(B) Propellant burning rate
(C) Bullet weight

NODIA

30. An abrasion collar (or contusion ring) typically seen around a gunshot entry wound is caused by:
(A) High-pressure muzzle gases expanding rapidly beneath the skin
(B) Unburnt gunpowder particles burning and searing the epidermis
(C) Bullet nose rubbing against skin as it enters
(D) The secondary exit of sharp bone fragments through the skin

31. Which of the following physical characteristics is most commonly associated with a typical exit wound?
(A) Presence of a prominent abrasion collar
(B) Presence of a dark bullet grease ring
(C) Heavy soot deposition around the wound
(D) Everted wound edges

32. In a hard contact gunshot wound over a flat bone like the skull, the expanding gases trapped between the skin and the bone often cause the wound to tear, resulting in a shape described as:
(A) Perfectly circular
(B) Crescent or moon-shaped
(C) Stellate (star-shaped)
(D) Oval with sharp margins

33. Consider the following statements regarding the characteristics of gunshot wounds:
I. An abrasion collar is typically a characteristic feature of an entry wound.
II. Exit wounds are universally smaller than their corresponding entry wounds in soft tissue.
III. In flat skull bones, internal bevelling (on the inner table) indicates an entry wound.
Which combination of statements is correct?
(A) I and II
(B) II and III
(C) I and III
(D) I, II and III

34. The presence of a "dirt ring" or "grease ring" around the margins of a bullet hole on a victim's clothing is diagnostic of:
(A) An exit hole
(B) A ricochet strike
(C) A distant range firing
(D) An entry hole

35. Tattooing or stippling around a gunshot entry wound is forensic evidence caused by:
(A) Unburnt powder grains embedding in skin
(B) Carbon monoxide gas chemically reacting with hemoglobin
(C) Dark soot particles wiping off from the bullet's surface
(D) Expanding hot muzzle gases singeing the epidermal hairs

36. Scorching and singeing of hair around a gunshot entry wound generally indicate that the weapon was fired from:
(A) A distant firing range extending beyond 3 yards
(B) An intermediate firing range of 2 to 3 yards
(C) Close or near-contact range
(D) An indirect ricochet trajectory from a surface

37. When an intermediate target, such as a glass window, is present between the muzzle of the firearm and the victim, it may cause the bullet to yaw or fragment. This typically results in an entry wound that is:
(A) Atypical and irregular entry
(B) Perfectly circular entry with a prominent bullet grease ring
(C) Uniformly smaller than the nominal caliber of the bullet
(D) Completely devoid of any measurable permanent cavity

38. The spread of shot pellets from a fired shotgun cartridge is primarily determined by the internal constriction at the muzzle of the barrel, known as the:
(A) Forcing cone
(B) Breech face
(C) Ejector
(D) Choke

39. In a shotgun cartridge, the primary function of the wad is to:
(A) Efficiently ignite the main smokeless powder charge
(B) Seal expanding gases behind shot payload
(C) Provide individual striae marks for forensic identification
(D) Securely hold the primer cup in place at the base

40. The "rat-hole" or scalloped appearance of a shotgun entry wound, where the main pellet mass enters as a single hole with irregular edges caused by early pellet separation, typically indicates a firing distance of approximately:
(A) Hard contact

Downloaded from www.pdf.tube

(C) Greater than 60 degrees
(D) Exactly 45 degrees

22. Given below are two lists: Match List I with List II.
List I: (Ballistic Terms)
P. Muzzle velocity
Q. Barrel time
R. Recoil
S. Harmonics
List II: (Definitions)
1. Rearward movement of the firearm
2. Speed of the projectile as it exits the bore
3. Vibrational waves traveling along the barrel
4. Duration the projectile spends inside the bore
(A) P-2, Q-4, R-1, S-3
(B) P-1, Q-3, R-2, S-4
(C) P-2, Q-1, R-4, S-3
(D) P-4, Q-2, R-1, S-3

23. Terminal ballistics is the sub-field of forensic ballistics that primarily studies:
(A) The aerodynamic forces acting on the bullet in mid-air
(B) Behavior of the projectile upon target impact
(C) The chemical residue left inside the firearm barrel
(D) The industrial manufacturing process of ammunition

24. In wound ballistics, which statement correctly distinguishes penetration from perforation?
(A) Penetration involves outer tissue stretching, while perforation involves inner tissue crushing.
(B) Penetration produces an exit wound, while perforation produces only an entry wound.
(C) Penetration stops in the target; perforation passes completely through.
(D) Penetration is caused by low-velocity bullets, while perforation is caused by shotgun pellets.

25. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): A high-velocity rifle bullet typically creates a much larger temporary cavity in soft tissue than a standard handgun bullet.
Reason (R): The kinetic energy transferred to the tissue, which drives temporary cavitation, increases with the square of the bullet's velocity.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

26. The permanent cavity created in a gunshot wound track represents:
(A) Tissue crushed and destroyed by the bullet's passage
(B) The tissue that is temporarily stretched and recoils back into place
(C) The extreme shockwave radius produced within body fluids
(D) The localized area of tissue bruising caused by muzzle blast

NODIA

27. Temporary cavitation in soft tissue is primarily the result of:
(A) The extreme thermal heat of the bullet cauterizing surrounding tissue
(B) Radial stretching of tissue away from the wound path
(C) Unburnt gunpowder grains entering and irritating the wound track
(D) The rapid gyroscopic spin of the bullet cutting tissue like a drill

28. The kinetic energy (KE) of a projectile, which correlates with its wounding potential, is calculated using the formula:
(A) KE = Mass × Velocity
(B) KE = $1/2$ × Mass × Velocity^2
(C) KE = Mass × Acceleration
(D) KE = $1/2$ × Mass^2 × Velocity

29. Which of the following options represents the correct sequence of physical events when a high-velocity bullet strikes and passes through soft tissue?
(A) Penetration → Permanent cavity formation → Hydrostatic shock wave → Temporary cavity expansion
(B) Hydrostatic shock wave → Penetration → Temporary cavity expansion → Permanent cavity formation
(C) Penetration → Hydrostatic shock wave → Temporary cavity expansion → Collapse leaving permanent cavity
(D) Temporary cavity expansion → Penetration → Hydrostatic shock wave → Permanent cavity formation

(D) Confirm the exact firing distance from which the shot was fired

50. Breech face marks are typically transferred to a cartridge case during firing because:
(A) The firing pin tip violently scrapes along the side wall of the case
(B) The mechanical extractor claw pulls the cartridge case out forcefully
(C) The metal ejector pin strikes the outer rim of the fired cartridge
(D) Cartridge base is forced backward against the breech face

51. Firing pin impressions on a fired cartridge case are primarily analyzed to compare:
(A) Microscopic defects on the firing pin tip
(B) The commercial manufacturer of the primer cap
(C) The relative depth of the seating of the primer
(D) The nominal class caliber of the suspect firearm

52. Ejector marks are imparted onto a fired cartridge case at which stage of the firing cycle?
(A) When the live cartridge is fully chambered into the bore
(B) When the primer cup is struck by the firing pin tip
(C) When case is expelled from the firearm
(D) When the bullet exits the muzzle of the firearm barrel

53. The instrument universally recognized as the gold standard for the simultaneous viewing and comparison of fired bullets and cartridge cases is the:
(A) Comparison Microscope
(B) Scanning Electron Microscope (SEM)
(C) Stereomicroscope
(D) Compound Light Microscope

54. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): In a shotgun injury, the presence of a distinct wad mark or abrasion on the victim's skin indicates a close-range firing.
Reason (R): Shotgun wads are lightweight and lose velocity rapidly, generally failing to travel beyond a few yards.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

55. In a comparison microscope used for ballistics, it is crucial that the lighting on both the evidence and test bullets is:
(A) Filtered in different contrasting colors to highlight details
(B) Matched in intensity and angle
(C) Sourced from completely independent overhead light fixtures
(D) Maintained as dim as possible to reduce surface glare

56. Which pioneer in forensic ballistics is widely credited with adapting the comparison microscope for the specific purpose of firearm identification in the 1920s?
(A) Alphonse Bertillon
(B) Edmond Locard
(C) Calvin Goddard
(D) Alec Jeffreys

57. The cherry-red discoloration of muscle tissue surrounding a close-range gunshot wound is caused by the reaction of hemoglobin with which muzzle gas?
(A) Carbon dioxide
(B) Nitrogen dioxide
(C) Sulfur dioxide
(D) Carbon monoxide

58. Which of the following represents the correct standard sequence of steps when examining a submitted firearm and its fired ammunition in a forensic science laboratory?
(A) Test firing → Trace evidence recovery → Class characteristics measurement → Microscopic comparison
(B) Trace evidence recovery → Class characteristics measurement → Test firing → Microscopic comparison
(C) Microscopic comparison → Test firing → Trace evidence recovery → Class characteristics measurement
(D) Class characteristics measurement → Microscopic comparison → Trace evidence recovery → Test firing

59. The automated ballistics imaging system used widely by forensic laboratories to digitize and compare marks on fired ammunition is known as:

Click Here to Buy book on Flipkart

(A) Rotational spin rate
(B) Ballistic coefficient
(C) Muzzle velocity
(D) Sectional density

79. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): When a bullet strikes and perforates the flat bones of the skull, the entry hole on the outer table is smaller and sharper than the defect on the inner table.
Reason (R): As the bullet passes through the bone, it pushes bone fragments forward, causing a cone-shaped defect known as internal bevelling.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

80. The "sectional density" of a bullet, which influences its penetration capabilities, is calculated by dividing the bullet's mass by the square of its:
(A) Length
(B) Velocity
(C) Diameter
(D) Ballistic coefficient

81. "Keyholing" observed on a target paper or victim's skin indicates that the bullet:
(A) Expanded perfectly symmetrically upon hitting target
(B) Tumbled or yawed severely at impact
(C) Struck the target surface at a precise 90-degree angle
(D) Completely fragmented into pieces prior to impact

82. The terminal velocity of a falling bullet (e.g., in celebratory gunfire) is the steady speed achieved when:
(A) The internal kinetic energy reaches its absolute maximum physical limit
(B) The gyroscopic spin rate drops completely to zero in mid-air
(C) The projectile begins to yaw excessively along its flight path
(D) Upward air drag equals downward gravity

83. Consider the following statements regarding types of rifling:
I. Button rifling is a cold-forming process that impresses grooves without cutting metal.
II. Broach cutting physically removes metal to create grooves.
III. Polygonal rifling uses sharply defined, traditional 90-degree cuts for its lands and grooves.
Which combination of statements is correct?
(A) I and III
(B) II and III
(C) I and II
(D) I, II and III

84. When examining a fired bullet under a comparison microscope, the accepted standard for declaring a "match" relies on finding sufficient agreement of:
(A) General class characteristics shared across same model
(B) Physical bullet weight and overall diameter measurements
(C) Consecutive matching striae (CMS)
(D) Chemical composition analysis of the internal lead core

85. The "bullet wipe" found on the edges of an entry wound or clothing is composed of:
(A) Soot, lubricant, and metals from bullet surface
(B) Biological blood and tissue fluid from the victim
(C) Microscopic nitrite crystals derived from burnt powder
(D) Unburnt gunpowder grains physically embedded in fabric

86. Which of the following is NOT an element typically analyzed using Scanning Electron Microscopy-Energy Dispersive X-ray (SEM-EDX) for the definitive confirmation of characteristic gunshot residue (GSR)?
(A) Lead
(B) Barium
(C) Antimony
(D) Carbon

87. If a firearm with an obliterated serial number is submitted for examination, which chemical reagent is routinely used for the restoration of numbers on a standard steel frame?
(A) Kastle-Meyer reagent solution
(B) Fry's reagent
(C) Marquis alkaloid reagent
(D) Modified Griess reagent

NODIA

69. Terminal ballistics of a soft-point or hollow-point bullet fired into soft tissue is characterized by:
(A) Rapid mushrooming and larger permanent cavity
(B) Complete structural integrity and deep penetration without deformation
(C) Immediate shattering into microscopic dust upon skin contact
(D) Passing straight through without transferring kinetic energy

70. The Walker test is a classical chemical test used on clothing to detect the presence of:
(A) Lead wipe residue deposited around entry
(B) Unburnt smokeless powder nitrates
(C) Metallic copper fragments from jacket
(D) Nitrite particles

71. Given below are two lists: Match List I with List II.
List I: (Firearm Components)
P. Breech face
Q. Firing pin
R. Extractor
S. Ejector
List II: (Marks Imparted)
1. Imparts marks on the primer cup indentation
2. Imparts marks on the base of the cartridge case during recoil
3. Imparts marks on the rim or extraction groove
4. Imparts marks on the edge of the case base upon expulsion
(A) P-2, Q-1, R-3, S-4
(B) P-1, Q-2, R-3, S-4
(C) P-2, Q-3, R-1, S-4
(D) P-3, Q-1, R-2, S-4

72. Broach cutting, button rifling, and hammer forging are all industrial methods used to:
(A) Industrially manufacture smokeless powder
(B) Precisely shape the hollow point of a bullet
(C) Rifle a firearm barrel
(D) Extrude cartridge cases from raw brass metal

73. Modern smokeless powder is classified as single-base or double-base. Double-base smokeless powder consists of nitrocellulose combined with:
(A) Black powder
(B) Lead azide
(C) Potassium perchlorate
(D) Nitroglycerin

74. Which of the following principles accurately explains why a bullet begins to drop the instant it leaves the muzzle, regardless of its forward velocity?
(A) Gravity accelerates all free-falling objects downward.
(B) Aerodynamic air drag continuously pulls the bullet downward toward earth.
(C) The aerodynamic Magnus effect forces the projectile directly toward ground.
(D) The gradual loss of gyroscopic spin stability causes downward yaw.

75. Arrange the following steps for the safe recovery of test bullets for comparison in a forensic laboratory in the correct operational order:
I. Mark the recovered bullet on its base or nose for chain of custody.
II. Unload the suspect firearm and visually verify that the chamber is empty and safe.
III. Retrieve the fired bullet from the tank using soft, rubber-tipped forceps.
IV. Fire the weapon safely into a water recovery tank or cotton waste box.
(A) II, IV, III, I
(B) IV, II, III, I
(C) II, III, IV, I
(D) IV, III, II, I

76. When recovering test bullets at a forensic laboratory, examiners prefer firing into a water tank rather than sand or earth because water:
(A) Rapidly cools down the firearm barrel between consecutive test shots
(B) Decelerates bullet without damaging striations
(C) Dissolves surface gunshot residue for subsequent chemical testing
(D) Significantly increases the muzzle velocity for clearer markings

NODIA

77. In external ballistics, the angle formed between the line of sight and the line of departure is known as the:
(A) Angle of elevation
(B) Angle of incidence
(C) Angle of yaw
(D) Angle of drift

78. A forensic examiner using a chronograph measures the time it takes for a bullet to pass between two light screens separated by a known distance. This instrument is used to determine the bullet's:

(A) AFIS
(B) IBIS
(C) CODIS
(D) NGI

60. Within the Integrated Ballistics Identification System (IBIS), the specific module designed to capture high-resolution 3D images of fired bullets is called:
(A) BrassTRAX
(B) BulletTRAX
(C) MatchPoint
(D) DataXchange

61. Consider the following statements regarding the evaluation of fired bullets:
I. The number of land and groove impressions is a class characteristic.
II. Striations within the land impressions are individual characteristics.
III. A full metal jacket bullet typically retains clearer and more distinct microscopic striations than a soft, unjacketed lead bullet.
Which combination of statements is correct?
(A) I and II
(B) II and III
(C) I and III
(D) I, II and III

62. In IBIS, the BrassTRAX module is primarily utilized to image and analyze:
(A) Fired bullets
(B) Gunshot residue particles
(C) Fired cartridge cases
(D) The internal rifling of the barrel

63. To chemically determine if a firearm has been recently fired, a forensic examiner might swab the interior of the barrel and test for the presence of nitrites. A common reagent for this test is:
(A) Lillie's reagent
(B) Marquis reagent
(C) Kastle-Meyer reagent
(D) Griess reagent

64. The dermal nitrate test (paraffin test) for gunshot residue on a shooter's hands is no longer considered definitive in modern forensics primarily because:
(A) It cannot detect modern smokeless powder components reliably.
(B) It is far too expensive and time-consuming to administer.
(C) It gives false positives for environmental nitrates.
(D) The hot paraffin wax permanently destroys skin ridge details.

65. The most reliable instrumental technique for confirming the presence of characteristic gunshot residue (GSR) particles containing Lead, Barium, and Antimony is:
(A) Gas Chromatography-Mass Spectrometry (GC-MS)
(B) Scanning Electron Microscopy with EDX (SEM-EDX)
(C) Fourier Transform Infrared Spectroscopy (FTIR)
(D) High-Performance Liquid Chromatography (HPLC)

66. Chamber marks are microscopic striations found on a fired cartridge case. They are transferred from the interior walls of the chamber due to:
(A) The violent forward action of the firing pin mechanism
(B) The mechanical extraction process after firing
(C) The spring-loaded feeding mechanism of the magazine
(D) Cartridge case obturation during firing

67. Which feature of a bullet is primarily designed to prevent lead fouling in the barrel at high velocities and to ensure reliable feeding in semi-automatic firearms?
(A) Metal jacket
(B) Hollow point tip design
(C) Boat tail base structure
(D) Circumferential cannelure

68. Consider the following statements regarding modern ballistic databases:
I. IBIS stands for Integrated Ballistics Identification System.
II. BulletTRAX captures images of cartridge cases.
III. BrassTRAX captures 2D and 3D images of breech face and firing pin impressions.
IV. NIBIN is a database network that utilizes IBIS technology for linking firearm crimes.
Which combination of statements is correct?
(A) I, II and III
(B) I, III and IV
(C) II, III and IV
(D) I and IV

Downloaded from www.pdf.tube

88. Given below are two lists: Match List I with List II.

List I: (Wound Ballistics Findings)

P. Tattooing

Q. Scorching

R. Abrasion collar

S. Grease ring

List II: (Primary Causes)

1. Friction of the spinning bullet stretching the skin
2. Transfer of lubricant and dirt from the bullet surface
3. Impact of unburnt powder grains embedding in the skin
4. Effect of hot muzzle gases and flame

(A) P-3, Q-4, R-1, S-2

(B) P-4, Q-3, R-1, S-2

(C) P-3, Q-4, R-2, S-1

(D) P-1, Q-2, R-3, S-4

89. The term "caliber" in a rifled firearm typically refers to the nominal distance measured between:

(A) Opposite grooves in the barrel

(B) The base of the cartridge to the tip of the bullet

(C) The breech face and the muzzle

(D) Opposite lands in the barrel

90. To preserve chain of custody and ensure uncompromised examination in a forensic science laboratory, recovered crime-scene firearms should ideally be packaged in:

(A) Cardboard boxes secured with zip-ties

(B) Sealed airtight plastic bags to prevent atmospheric rusting

(C) Moisture-resistant envelopes containing water to preserve residue

(D) Protective wrapping tissue heavily coated in heavy gun oil

NODIA

41. (D) Cylinder bore
A cylinder bore barrel features no internal choke constriction at the muzzle. Under standard conditions, shot pellets disperse continuously upon exiting an unchoked barrel. A common forensic rule of thumb estimates that for a cylinder bore shotgun, pellet pattern spread diameter in inches approximates the firing distance measured in yards remarkably well.

42. (A) I, II and IV
Hard contact skull wounds show stellate tears due to subgaleal gas expansion. Stippling involves unburnt powder grains embedded mechanically into dermal skin, making them impossible to wash off. Grease rings deposit on target surfaces during entrance. Conversely, singeing of body hair occurs exclusively during close or near-contact firing rather than distant range shots.

43. (B) No two firearms produce identical microscopic markings.
The principle of firearm identification asserts that manufacturing tools leave microscopic, random imperfections on internal metallic surfaces of gun components. These microscopic toolmarks are unique to each individual firearm. Consequently, no two firearms, even if sequentially manufactured by the same machinery, impart identical microscopic striations onto fired bullets or cartridge cases during discharge.

44. (B) Number, width, and twist direction of lands and grooves
Class characteristics are deliberate design features specified by manufacturers prior to production. In rifled firearm barrels, these include caliber dimensions, the total number of lands and grooves, their specific widths, and their direction of twist (right or left). These parameters permit narrowing down candidate firearms to specific makes or models during analysis.

45. (A) Microscopic striations in land/groove impressions
Individual characteristics are random, microscopic irregularities produced by manufacturing tool wear, corrosion, and usage patterns inside a firearm's bore. As a bullet passes through the barrel, these microscopic toolmarks scratch fine striations into land and groove impressions, providing unique evidence that allows matching a bullet back to a single individual weapon.

46. (C) Extraction groove
The extractor is a spring-loaded metal claw in semi-automatic and automatic firearms designed to withdraw the fired cartridge case from the chamber. During cycling, the extractor hooks securely into the extraction groove (or behind the rim) of the cartridge case, leaving distinct microscopic mechanical scratches and toolmarks along its channel during extraction.

47. (A) P-2, Q-4, R-1, S-3
Modified Griess Reagent reacts specifically with nitrites derived from partially burnt smokeless powder. Sodium Rhodizonate detects lead particles around bullet holes. Diphenylamine tests for nitrates found in unburnt propellant powder grains. The Harrison-Gilroy Reagent detects heavy metals including lead, barium, and antimony present in organic primer discharge residues during forensic chemical testing.

48. (C) Land impressions
The internal bore of a rifled firearm contains alternating raised ridges (lands) and cut valleys (grooves). As a bullet passes through the barrel under gas pressure, the raised lands press into the projectile's outer jacket or lead body, imparting depressed longitudinal channels called land impressions on the bullet surface during bore travel.

49. (B) Determine class characteristics to narrow possible makes
Bullet caliber (9mm), total land impression count (6), and twist direction (right-hand) constitute class characteristics. Class characteristics are predetermined manufacturing design traits that identify groups of firearm makes and models sharing identical barrel specifications. Individual identification requires microscopic comparison of fine striations, which class data alone cannot provide without detailed lab testing.

50. (D) Cartridge base is forced backward against the breech face
Upon propellant ignition, intense equal and opposite internal gas pressure forces the expand end of the cartridge base violently backward against the stationary breech face of the firearm chamber. This massive pressure forces the softer metal of the cartridge primer and case head to stamp microscopic machining toolmarks directly from the breech face surface.

Click Here to Buy book on Amazon

combustion and bore travel, including barrel length, bullet mass, and powder burn rates. Environmental conditions outside the barrel, such as crosswind speed, ambient temperature, and atmospheric pressure, act on the projectile only during external ballistics after it has cleared the muzzle.

11. (B) When the bullet leaves the muzzle
External ballistics is the branch of flight dynamics that studies the projectile's motion through atmosphere. This phase begins precisely at the instant the bullet's base emerges from the firearm's muzzle, leaving the enclosed barrel behind, and continues continuously as it travels through flight until it strikes a target surface, initiating terminal ballistics.

12. (A) I and II
During flight, gravity continuously pulls the projectile toward the earth, giving the trajectory a parabolic arc. Atmospheric drag exerts a retarding force opposing forward motion. The Magnus effect applies to any rotating body in air, including spin-stabilized rifle bullets, rather than being restricted exclusively to smoothbore projectiles or unspun shotgun slugs in flight.

13. (A) Gravity and time of flight
In a complete vacuum, atmospheric resistance and aerodynamic drag are entirely absent. Consequently, horizontal velocity remains constant, and vertical displacement depends exclusively on gravitational acceleration acting over time. The vertical downward drop is governed directly by standard free-fall kinematics, where drop equals one-half of gravitational acceleration multiplied by square of elapsed flight time.

14. (C) Square of its velocity
Aerodynamic drag force acting on an object moving through air is defined by fluid dynamics principles. For projectiles moving at high speeds, aerodynamic resistance increases exponentially relative to velocity. Specifically, drag force is directly proportional to air density, frontal cross-sectional area, drag coefficient, and the square of the projectile's forward flight velocity achieved.

15. (A) III, I, IV, II
Upon leaving the muzzle, the bullet rises above the bore line and first crosses the line of sight. It ascends continuously until reaching the apex of its trajectory, termed maximum ordinate. Gravity then pulls the falling projectile below the line of sight along its descending branch before it ultimately strikes the intended target surface.

16. (C) Ability to overcome air resistance
The ballistic coefficient quantifies a projectile's aerodynamic efficiency and capacity to resist decelerating drag forces during flight. Derived from sectional density divided by the form factor, a higher ballistic coefficient indicates that a bullet retains velocity better, resists crosswind deflection more effectively, and maintains a flatter overall aerodynamic trajectory path in flight.

17. (B) Line of elevation
The line of elevation is the imaginary straight trajectory line projected through the longitudinal axis of the firearm bore prior to discharge. Because gravity immediately pulls the bullet downward upon exiting the barrel, firearms must be pointed upward relative to the target line of sight, creating an elevation angle between both reference lines.

18. (C) I, II and III
Yaw is the angle between a bullet's longitudinal axis and its flight trajectory. Precession represents the circular rotation of its nose around the center of gravity, while nutation describes minor nodding oscillations superimposed on precession. Gyroscopic spin provides stabilization but cannot instantly eliminate yaw at muzzle exit due to gas blast forces.

19. (A) Twist rate of the barrel
Gyroscopic stability prevents spinning bullets from tumbling during flight. This stability depends on the barrel twist rate, which specifies the distance required for the internal rifling to make one complete revolution. Proper twist rates impart sufficient rotational speed to counterbalance overturning aerodynamic forces, maintaining point-forward stability throughout the projectile trajectory path in air.

20. (C) The Magnus effect
When a spinning bullet travels through a crosswind, relative airflow across its rotating surface creates differential air pressure on opposite sides. This asymmetry generates a sideways force known as the Magnus effect. This aerodynamic phenomenon deflects the projectile

NODIA

digital format for automated database comparison and evaluation in forensic laboratories.

61. (D) I, II and III
Number of lands and grooves is a class characteristic determined by barrel design. Fine striations inside land impressions are unique individual toolmarks formed during manufacturing and wear. Full metal jacketed bullets maintain structural integrity, preserving clearer, more distinct microscopic striations than soft lead bullets, which deform easily upon target impact during firing events.

62. (C) Fired cartridge cases
BrassTRAX is the automated acquisition component of the Integrated Ballistics Identification System designed for imaging fired cartridge cases. It captures high-resolution 2D and 3D topographic images of breech face impressions, firing pin impressions, and ejector marks on cartridge bases, converting these physical features into mathematical algorithms for database searches in forensic labs.

63. (D) Griess reagent
The Griess test is a colorimetric chemical reaction utilized to detect nitrite ions derived from partially combusted nitrocellulose smokeless powder. Swabbing the internal bore of a firearm and applying Griess reagent yields a characteristic magenta or pink dye, confirming the presence of combustion residues and indicating that the firearm was discharged recently.

64. (C) It gives false positives for environmental nitrates.
The dermal nitrate test, or paraffin cast test, uses diphenylamine reagent to detect nitrates on hands. Modern forensics abandoned this test due to high non-specificity. Common environmental and occupational substances, such as fertilizers, tobacco, matches, cosmetics, and pharmaceuticals, contain nitrates that produce false positive reactions indistinguishable from gunshot residue during chemical testing.

65. (B) Scanning Electron Microscopy with EDX (SEM-EDX)
Scanning Electron Microscopy paired with Energy Dispersive X-ray Spectroscopy (SEM-EDX) is the definitive analytical technique for gunshot residue analysis. SEM locates microscopic particles based on characteristic spherical morphology, while EDX confirms elemental composition by detecting lead, barium, and antimony simultaneously, establishing condensed primer discharge residue without sample destruction testing in laboratory.

66. (D) Cartridge case obturation during firing
During propellant combustion, internal gas pressure expands the thin metal cartridge case outward against the steel chamber walls, a phenomenon termed obturation. This intense mechanical expansion seals gas leakage but forces the cartridge metal to mold into microscopic rough surfaces and machining imperfections on chamber walls, transferring distinct striations onto cases during firing.

67. (A) Metal jacket
A metal jacket, typically composed of copper alloy or mild steel, encloses a bullet's soft lead core. Operating at high velocities, unjacketed lead bullets melt or scrape off inside barrel rifling, causing severe lead fouling. Metal jackets resist high temperatures and forces, preventing lead residue while ensuring smooth feeding in semi-automatic mechanisms during cycling.

68. (B) I, III and IV
IBIS is an automated identification framework. BrassTRAX captures 2D and 3D imagery of breech face and firing pin toolmarks on cartridge cases, whereas BulletTRAX handles bullet imaging. NIBIN serves as the nationwide automated network linking firearms evidence submitted across jurisdictions using IBIS technology to assist crime investigations in forensic science laboratories nationwide.

69. (A) Rapid mushrooming and larger permanent cavity
Soft-point and hollow-point expanding bullets feature structural nose cavities or exposed lead cores engineered to expand dynamically upon entering fluid-dense tissue. Hydraulic pressure forces the front of the bullet to peel back and flatten into a mushroom shape, increasing frontal area, enhancing kinetic energy transfer, and creating a larger permanent cavity during penetration.

70. (D) Nitrite particles
The Walker test is a classical chemical examination performed on target fabrics to detect nitrite particles produced by partially burned smokeless

Downloaded from www.pdf.tube

stretches the elastic skin before perforating it. The friction of the spinning bullet nose rubbing against the inverted skin margins abrades the superficial epidermal layer, creating this characteristic forensic wound feature.

31. (D) Everted wound edges
Exit wounds occur when a bullet exits body tissues. Unlike entry wounds, which feature inverted edges, abrasion collars, and soot or powder deposition, exit wounds typically display everted (turned-outward) skin edges, irregular or stellate shapes, and an absolute absence of gunshot residues or surrounding skin abrasion margins on external forensic examination.

32. (C) Stellate (star-shaped)
In hard contact gunshot wounds over flat underlying bones, expanding high-pressure propellant gases enter the subcutaneous tissue directly. Unable to escape deeper, these trapped gases expand violently against the unyielding bone, tearing the overlying stretched skin outward along natural tension lines, producing a characteristic stellate or star-shaped lacerated wound outline in skin tissue.

33. (C) I and III
Abrasion collars are primary diagnostic indicators of entry wounds caused by bullet friction against stretched skin. When penetrating flat skull bones, bullets displace bone fragments forward, creating internal bevelling on the inner table at entry. Exit wounds are not universally smaller than entry wounds and can be significantly larger depending on bullet deformation.

34. (D) An entry hole
A bullet grease or dirt ring is a dark, distinct smudge deposited on clothing or skin at the immediate entrance site. As the bullet exits the barrel, its exterior carries bore lubricants, lead particles, burnt propellant residue, and metallic debris, which wipe off onto target fibers upon initial contact, confirming an entry hole site.

35. (A) Unburnt powder grains embedding in skin
Tattooing, or stippling, consists of numerous punctate, reddish-brown abrasive skin lesions surrounding a gunshot entry wound. It is produced when partially burnt or unburnt gunpowder grains exit the muzzle at high velocity and impact the skin at intermediate range, embedding into the epidermis without washing off, establishing intermediate firing distance during examination.

NODIA

36. (C) Close or near-contact range
Thermal effects such as scorching of fabric, singeing of cutaneous hair, and localized thermal burning surrounding a gunshot entry wound indicate a close or near-contact firing range. Superheated muzzle gases and flame produced by burning propellant dissipate rapidly in air, extending outward only a short distance from the muzzle tip during weapon discharge.

37. (A) Atypical and irregular entry
Perforating an intermediate target such as glass destabilizes a bullet, causing severe yaw, tumbling, or structural fragmentation before reaching the body. Consequently, the resulting entrance wound loses its typical circular geometry, appearing irregular, jagged, or displaying multiple atypical satellite entry defects, complicating standard distance and trajectory evaluations in forensic ballistic analysis.

38. (D) Choke
The choke is a subtle tapering constriction located at the muzzle end of a shotgun barrel designed to control shot pellet dispersion. By constricting the shot column as it exits the barrel, different degrees of choke determine the density and dispersion rate of the pellet pattern over specified target distances during external flight.

39. (B) Seal expanding gases behind shot payload
The wad in a shotgun shell serves as a crucial gas seal positioned between the propellant powder and the shot payload. Upon ignition, the wad expands under pressure to form an airtight obturation seal, preventing high-pressure gases from blowing past the pellets while pushing the payload efficiently down the smoothbore barrel interior during discharge.

40. (B) 1 to 3 yards
At very close ranges of 1 to 3 yards, the pellet mass exiting a shotgun barrel begins to emerge from the protective plastic wad. Individual pellets along the periphery start separating slightly, producing a central entry hole with scalloped or notched borders, classically referred to as a "rat-hole" defect in forensic pathology evaluations.

by the square of its diameter. Projectiles possessing higher sectional density experience lower atmospheric drag and penetrate deeper into targets due to increased mass per area.

81. (B) Tumbled or yawed severely at impact
Keyholing refers to an elongated, irregular entry hole resembling a skeleton keyhole on target media or tissue. This defect occurs when a bullet loses gyroscopic stability in flight and strikes sideways or at an extreme yaw angle, rather than entering point-first, often due to improper rifling twist or obstacle interaction during flight.

82. (D) Upward air drag equals downward gravity
When a bullet fired vertically into the air loses its momentum and falls back toward earth under gravity, air drag opposes its descent. Terminal velocity is achieved when the upward aerodynamic drag force grows equal in magnitude to the downward force of gravity, balancing net acceleration and producing a constant falling speed downward.

83. (C) I and II
Button rifling cold-forms spiral grooves by pressing a hardened carbide plug through the bore without cutting metal, whereas broach cutting physically cuts away spiral grooves. Polygonal rifling avoids traditional sharp 90-degree land cuts, featuring smooth hill-and-valley contours with rounded transitions that provide improved gas sealing and reduce barrel wear firing processes.

84. (C) Consecutive matching striae (CMS)
Consecutive Matching Striae (CMS) provides a quantitative, objective standard for declaring individual toolmark identifications in forensic ballistics. Establishing a match requires observing a specific minimum number of three-dimensional, consecutive matching microscopic line patterns (striae) in the same relative position across land impressions of both evidence and test-fired bullets examination under microscope.

85. (A) Soot, lubricant, and metals from bullet surface
Bullet wipe is a dark, ring-like deposit transferred onto target clothing or skin edges immediately surrounding an entrance hole. As a bullet passes through the gun barrel, its surface collects combustion soot, primer residue, bullet lubricant, lead particles, and metallic scraping, which wipe off onto target material upon initial penetration.

86. (D) Carbon
Characteristic primer gunshot residue particles are defined by the specific tri-elemental combination of lead, barium, and antimony derived from primer caps. Although carbon is present in organic powder residues, atmospheric air, and mounting stubs, it is ubiquitous in nature and excluded from criteria used for establishing characteristic metallic primer residue identification.

87. (B) Fry's reagent
Stamping serial numbers onto steel firearm frames induces plastic deformation, disrupting the underlying crystalline grain structure. When numbers are ground off, this sub-surface strain remains. Fry's reagent, an acid etching solution containing cupric chloride, hydrochloric acid, and water, preferentially etches the strained crystal structure, temporarily restoring visibility of numbers during forensic examination.

88. (A) P-3, Q-4, R-1, S-2
Tattooing results from unburnt gunpowder grains impacting skin. Scorching is caused by heat and flame from muzzle gases. An abrasion collar forms from friction as the spinning bullet depresses and stretches skin. A grease ring deposits as lubricant, lead, and dirt wipe off the bullet surface during skin entry in shooting incidents.

89. (D) Opposite lands in the barrel
In firearm terminology, caliber designates the nominal internal diameter of a rifled barrel. In traditional measurement systems, caliber is determined by calculating the distance between two opposing uncut raised surfaces (lands) within the barrel, prior to the cutting of grooves, expressing bore size in decimal fractions or millimeters accurately during design.

90. (A) Cardboard boxes secured with zip-ties
Forensic evidence packaging standards require securing recovered firearms inside rigid cardboard boxes using plastic zip-ties through the trigger guard and frame. This packaging prevents physical movement, protects delicate latent fingerprints and trace evidence, avoids plastic condensation moisture that causes rusting, and

Click Here to Buy book on Flipkart

51. (A) Microscopic defects on the firing pin tip
When a firearm is discharged, the firing pin strikes the primer cup to initiate ignition. This impact transfers the unique contour, machining marks, and microscopic wear defects of the firing pin tip into the soft metal indentation, allowing examiners to microscopically compare fired evidence cases with test-fired cases from suspect weapons directly under microscope.

52. (C) When case is expelled from the firearm
During the automatic or semi-automatic extraction cycle, the fired cartridge case is pulled backward by the extractor until its rim violently strikes a fixed or spring-loaded metal projection called the ejector. This impact flips the spent case out of the ejection port, stamping distinct individual toolmarks onto the cartridge rim base during expulsion.

53. (A) Comparison Microscope
The comparison microscope consists of two compound light microscopes connected by an optical bridge. This arrangement projects side-by-side split-field images of two separate objects into a single eyepiece field. It enables firearm examiners to concurrently observe, align, and match fine microscopic striations across evidence bullets or cartridge cases with test-fired specimens in laboratory testing.

54. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Shotgun wads possess low mass and poor aerodynamic properties, causing them to decelerate rapidly upon exiting the muzzle. Consequently, wads travel only a short distance, usually falling within a few yards. If a wad leaves an impression or abrasion on skin, it proves the discharge occurred at close range before complete wad deceleration occurs.

55. (B) Matched in intensity and angle
During microscopic striation comparison under a forensic comparison microscope, identical oblique illumination is essential. Differences in light angle or intensity generate artificial shadows and highlight variations on cylindrical bullet surfaces, distorting microscopic toolmarks. Matching light intensity, direction, and angle ensures consistent, accurate side-by-side evaluation of fine striations across both specimens under view.

56. (C) Calvin Goddard
Major Calvin Goddard was a pioneer in forensic ballistics who adapted the comparison microscope for firearm identification in the 1920s. By combining two microscopes through an optical bridge, Goddard established scientific methodology for matching striations on fired bullets and cartridge cases, playing a key role in landmark investigations like the St. Valentine's Day Massacre.

57. (D) Carbon monoxide
In close-range or contact gunshot wounds, combustion products including carbon monoxide gas are forced directly into subcutaneous tissues. Carbon monoxide binds strongly with myoglobin in muscle tissue and hemoglobin in blood to form carboxyhemoglobin and carboxymyoglobin. This chemical binding produces a bright cherry-red discoloration characteristic of near-contact wound sites upon examination.

58. (B) Trace evidence recovery → Class characteristics measurement → Test firing → Microscopic comparison
Forensic protocol mandates recovering fragile trace evidence, such as fingerprints or DNA, before handling alters the weapon. Next, examiners record class characteristics of the firearm and evidence. Subsequently, test firing is performed in a water tank to obtain exemplar bullets and cases, concluding with side-by-side microscopic comparison under a comparison microscope system.

59. (B) IBIS
The Integrated Ballistics Identification System (IBIS) is an automated ballistics technology used by forensic laboratories to acquire high-resolution digital images of toolmarks on fired bullets and cartridge cases. IBIS algorithms compare these digital images against regional and national databases, highlighting potential matches for verification by qualified firearm examiners in crime labs systematically.

60. (B) BulletTRAX
BulletTRAX is a specialized hardware acquisition unit within the IBIS ecosystem designed to capture high-resolution 3D topographic images of land and groove impressions on fired bullets. It rotates the bullet, scanning its circumferential surface to map fine microscopic striations into a

Downloaded from www.pdf.tube

laterally and vertically, compounding crosswind drift and shifting the target point of impact significantly during flight.

21. (A) Very small or acute
A ricochet occurs when a projectile glances off an intervening surface rather than penetrating or shattering. Small or acute angles of incidence present insufficient normal impact force to breach hard materials like concrete, steel, or glass, causing the bullet to glance off, deform, and continue along an altered deflection trajectory path afterwards.

22. (A) P-2, Q-4, R-1, S-3
Muzzle velocity measures projectile exit speed at the barrel mouth. Barrel time denotes the duration a bullet spends moving inside the bore. Recoil describes the rearward impulse of the gun upon firing due to momentum conservation. Harmonics represent elastic vibrational waves traversing along the metal barrel during high-pressure propellant combustion processes inside.

23. (B) Behavior of the projectile upon target impact
Terminal ballistics focuses on physical interactions that occur when a projectile impacts and penetrates a target material. This discipline evaluates kinetic energy transfer, bullet deformation, fragmentation, ricochet dynamics, structural penetration, and wound patterns in biological tissue, aiding forensic examiners in reconstructing shooting events and determining cause of injury accurately.

24. (C) Penetration stops in the target; perforation passes completely through.
In wound ballistics, penetration refers to a projectile entering a target or anatomical structure without exiting, coming to rest inside the target material. Conversely, perforation defines a complete passage where the bullet enters through one surface, traverses the tissue or material completely, and exits through an opposite outlet wound site completely.

25. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Kinetic energy is calculated as one-half mass multiplied by velocity squared. Because kinetic energy increases exponentially with velocity, high-velocity rifle projectiles carry far greater kinetic energy than slower handgun bullets. Upon impact, this rapid energy dissipation radially displaces surrounding soft tissues, forming a significantly larger temporary cavity along the wound track.

26. (A) Tissue crushed and destroyed by the bullet's passage
The permanent cavity in wound ballistics represents the physical track of permanently destroyed tissue resulting directly from mechanical crushing by the striking bullet. Unlike the temporary cavity, which expands outward and stretches tissue before elastic recoil, the permanent cavity consists of permanently sheared, cut, and devitalized tissue along the projectile trajectory track line.

27. (B) Radial stretching of tissue away from the wound path
Temporary cavitation occurs when high-velocity bullets transfer kinetic energy rapidly to surrounding fluids in soft tissue during penetration. This kinetic energy transfer accelerates tissue radially outward, away from the central bullet track, creating a transient, highly expanded cavity that stretches elastic membranes before contracting back toward its equilibrium state after initial impact.

NODIA

28. (B) KE = 1/2 x Mass x Velocity^2
Kinetic energy measures the work capability of a moving projectile and is defined as one-half of the projectile mass multiplied by the square of its velocity. Because velocity is squared in this relationship, doubling bullet velocity quadruples available kinetic energy, making velocity the primary mechanical determinant of wounding potential during impact penetration.

29. (C) Penetration → Hydrostatic shock wave → Temporary cavity expansion → Collapse leaving permanent cavity
When a high-velocity bullet strikes soft tissue, initial penetration initiates bullet passage, generating a supersonic hydrostatic shock wave through fluid media. The rapid transfer of kinetic energy causes dynamic radial expansion of a temporary cavity, which stretches tissues before collapsing back, leaving the crushed permanent cavity behind as the residual wound track.

30. (C) Bullet nose rubbing against skin as it enters
An abrasion collar is a reddish-brown, inverted ring of denuded epidermis surrounding an entry wound. As the bullet penetrates, it indents and

gunpowder. Utilizing desensitized photographic paper treated with sulfanilic acid and alpha-naphthylamine in acetic acid, the test develops orange-red spots corresponding geographically to nitrite distributions around entry sites range testing.

71. (A) P-2, Q-1, R-3, S-4
The breech face impacts the cartridge base during recoil expansion. The firing pin strikes the primer cup to leave a distinct central indentation. The extractor hook engages the extraction groove or cartridge rim to pull the case back. The ejector strikes the rim edge during expulsion, flinging the spent cartridge case clear of action.

72. (C) Rifle a firearm barrel
Broach cutting, button rifling, and cold hammer forging represent primary manufacturing processes used to produce helical lands and grooves inside a firearm barrel. Broach cutting physically cuts metal grooves, button rifling displaces metal using a hardened steel plug, and hammer forging compresses metal around an internal mandrel to form rifling within the bore.

73. (D) Nitroglycerin
Smokeless powders are modern solid propellants categorized by chemical composition. Single-base powders contain energetic nitrocellulose as their sole explosive base component. Double-base smokeless powders incorporate liquid nitroglycerin absorbed into nitrocellulose, increasing potential energy density, combustion temperature, and gas generation rate to achieve superior propulsive ballistics performance in firearms during discharge and firing.

74. (A) Gravity accelerates all free-falling objects downward.
As soon as a bullet exits the gun muzzle, it becomes an unconstrained projectile subject to earth's gravitational field. In accordance with classical gravitational physics, gravity exerts a constant vertical downward acceleration on all free-falling objects regardless of horizontal velocity, causing the bullet to begin dropping immediately upon entering free flight path air.

75. (A) II, IV, III, I
Safe test firing in a forensic laboratory requires verifying the firearm is completely unloaded first. Next, the examiner fires test rounds into a water recovery tank. The bullet is then carefully retrieved using non-marring, soft rubber-tipped forceps to protect microscopic striations, before finally marking the base or nose for chain of custody tracking.

76. (B) Decelerates bullet without damaging striations
Firing into a water tank is the preferred method for test bullet recovery because water acts as an effective, non-abrasive decelerating medium. Liquid drag absorbs the bullet's kinetic energy smoothly, stopping it safely without causing mechanical distortion, nose mushrooming, or altering fine microscopic striations essential for forensic comparison under a microscope examination.

77. (A) Angle of elevation
In external ballistics, the angle of elevation is the vertical angle formed between the line of sight (connecting eye, sights, and target) and the line of departure (axis of bore at projectile exit). Compensating for gravitational drop during trajectory requires angling the barrel upward above the sightline, establishing elevation angle for accurate targeting.

78. (C) Muzzle velocity
A ballistic chronograph calculates projectile velocity by recording the precise elapsed time required for a bullet to pass between two photoelectric light sensors separated by a fixed distance. Dividing the measured distance by travel time determines bullet flight speed near the muzzle, providing exact muzzle velocity data for internal and external ballistic calculations accurately.

79. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
When a bullet perforates flat cranial bones, it creates a clean, well-defined circular hole on the outer table. As it penetrates deeper, momentum pushes bone fragments forward, expanding the defect crater on the inner table. This progressive displacement creates internal bevelling, confirming the entrance side of the cranial defect during pathological autopsy.

80. (C) Diameter
Sectional density is an important ballistic parameter that quantifies a bullet's mass distribution relative to its cross-sectional area. It is calculated by dividing total bullet weight

Click Here to Buy book on Amazon

ANSWERS

1. (B) Internal ballistics
Internal ballistics is the subdiscipline of forensic ballistics focusing on physical and chemical phenomena occurring from the moment the firing pin strikes the primer until the projectile exits the firearm barrel. It encompasses propellant ignition, gas expansion, chamber pressure generation, bullet movement through the bore, rifling engagement, and recoil forces within the gun during firing.

2. (D) To ignite the main propellant charge
The primer in a centerfire cartridge contains a sensitive primary explosive compound that detonates upon mechanical impact from the firing pin. This detonation produces an intense flame and hot gases, which pass through the flash hole of the cartridge case to rapidly ignite the main propellant powder charge, initiating the combustion necessary to drive the bullet forward.

3. (A) Lead styphnate
Modern non-corrosive primer compositions utilize lead styphnate (lead 2,4,6-trinitroresorcinate) as the primary explosive initiator due to its excellent impact sensitivity, chemical stability, and reliable ignition properties. Unlike older mercury fulminate or potassium chlorate primers, lead styphnate does not cause barrel corrosion or metallic embrittlement while reliably setting off the main explosive propellant mixture.

4. (C) 40,000 to 65,000 psi
Standard centerfire rifle cartridges generate immense pressures during propellant deflagration inside the firearm chamber to achieve high projectile muzzle velocities. Modern rifle ammunition, such as the .223 Remington or .308 Winchester, is designed to operate safely within a maximum peak chamber pressure range of 40,000 to 65,000 pounds per square inch, established by industry standards.

5. (A) Engraving
Engraving is the physical process where a fired bullet enters the rifled bore of a firearm and is violently pressed against the helical lands and grooves. As high gas pressure pushes the projectile forward, its metal outer surface deforms, taking negative impressions of the bore features, which imparts rotational spin and distinct individual striations onto it.

6. (D) Primer strike to bullet exit from the muzzle
Barrel time represents the total duration that elapses from the instant the firing pin strikes the primer cup to the precise moment the base of the projectile completely clears the muzzle of the gun barrel. In typical small arms, barrel time is extremely brief, usually lasting between one and four milliseconds depending on internal factors.

NODIA

7. (B) Conservation of linear momentum
The physical force and motion of recoil are governed by the law of conservation of linear momentum, which dictates that total momentum in a closed system remains constant before and after firing. The forward momentum of the bullet and exiting propellant gas equal the rearward momentum of the firearm, allowing calculation of free recoil velocity.

8. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
According to the conservation of momentum, firearm mass multiplied by recoil velocity equals projectile mass multiplied by ejection velocity. Increasing the mass of the firearm reduces its backward velocity proportionally when firing the same cartridge. Consequently, a heavier rifle experiences lower physical recoil velocity, producing significantly less felt recoil force felt by the shooter directly.

9. (D) The consistency of the point of impact
High pressure and bullet movement cause the barrel to flex and oscillate in wave patterns known as barrel harmonics. If the bullet exits at inconsistent points during these vibrational wave cycles, the angle of departure changes slightly from shot to shot, directly altering the projectile's point of impact and reducing overall firearm accuracy and precision.

10. (A) Crosswind speed
Internal ballistics deals exclusively with events taking place within the firearm during propellant

maintains secure chain of custody integrity during laboratory transport and storage.

www.nodia.in

Downloaded from www.pdf.tube

but Reason (R) is not the correct explanation of Assertion (A).
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

18. The Harrison and Gilroy chemical color test utilizes triphenylmethylarsonium iodide primarily to detect the presence of which element in gunshot residue?
(A) Copper
(B) Zinc
(C) Antimony
(D) Titanium

19. The Walker test is a classical chemical method historically used to detect which specific component of gunshot residue on clothing?
(A) Unburnt smokeless powder (Nitrates)
(B) Partially burnt powder (Nitrites)
(C) Lead particles
(D) Barium particles

20. When analyzing gunshot residue using Atomic Absorption Spectroscopy (AAS), what is the most significant limitation of this technique compared to SEM-EDX?
(A) AAS is entirely unable to detect elemental lead or barium in any forensic sample
(B) AAS requires several weeks of laboratory processing for a single swab sample
(C) AAS requires massive quantities of physical sample, exceeding ten grams total
(D) AAS provides bulk elemental analysis without revealing particle morphology

21. Neutron Activation Analysis (NAA) is a highly sensitive instrumental technique for detecting GSR. However, it is primarily limited because it cannot effectively detect which of the classical GSR elements?
(A) Lead
(B) Barium
(C) Antimony
(D) Copper

22. Consider the following statements regarding SEM-EDX analysis of gunshot residue:
I. It is considered a destructive technique.
II. It provides simultaneous visualization of particle morphology and elemental composition.
III. It is widely regarded as the gold standard for conclusive GSR particle identification.
Which of the above statement(s) is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

23. Under a Scanning Electron Microscope, classic inorganic gunshot residue particles typically range in size from 0.5 to 5 micrometers and exhibit which type of surface morphology?
(A) Spheroidal or nodular
(B) Perfectly cubic and jagged shape
(C) Long, fibrous, needle-like structure
(D) Flat, hexagonal metallic flakes

24. A forensic scientist detects multiple three-component (Pb-Ba-Sb) particles on a suspect's hand via SEM-EDX. What is the most scientifically sound conclusion the expert can report in court?
(A) The suspect definitely discharged a firearm during the commission of the alleged shooting incident.
(B) The suspect was absolutely located within three feet of a discharging weapon when it was fired.
(C) The suspect is unequivocally and demonstrably the perpetrator of the entire shooting incident.
(D) The suspect discharged a firearm, was near a firing weapon, or touched a GSR-bearing item.

25. Consider the following everyday occupational or environmental sources:
I. Automotive brake pads
II. Fireworks and pyrotechnics
III. Industrial stud guns
IV. Lead-acid batteries
Which of the above sources can produce microscopic particles containing elements (like Barium, Antimony, or Lead) that might cause false positives in elemental GSR screening if morphology is ignored?
(A) I, II, and III
(B) I, III, and IV
(C) II, III, and IV
(D) I, II, III, and IV

26. When estimating the firing distance from a gunshot residue pattern on a victim's clothing, the presence of a highly concentrated, dense deposit of soot directly around the bullet hole with severe fabric tearing generally indicates which range of fire?

NODIA

9. Under normal active circumstances, gunshot residue deposited on the bare hands of a living shooter is generally expected to be lost or rendered undetectable through normal activity and friction after approximately how much time?
(A) 30 to 45 minutes
(B) 4 to 6 hours
(C) 24 to 48 hours
(D) 72 to 96 hours

10. In the context of gunshot residue, what does the term "secondary transfer" mean?
(A) The deposition of GSR onto a secondary target located behind the primary target
(B) The chemical breakdown of GSR particles into secondary metallic compounds over time
(C) Transfer of GSR from a fired weapon or contaminated surface to a person's hands
(D) The subsequent firing of a second cartridge from the same firearm during an incident

11. When collecting gunshot residue from the hands using the swabbing technique, which of the following solutions is commonly used to moisten the cotton swabs?
(A) 10% Sodium hydroxide aqueous solution
(B) Concentrated sulfuric acid solution
(C) Pure acetone organic solvent solution
(D) 5% Nitric acid or hydrochloric acid

12. Match the specific gunshot residue chemical test in List I with its primary target substance in List II:
List I: (Chemical Test)
P. Modified Griess Test
Q. Sodium Rhodizonate Test
R. Harrison and Gilroy Test
S. Diphenylamine Test
List II: (Target Substance)
1. Antimony
2. Nitrites
3. Lead and Barium
4. Nitrates and Nitrites
(A) P-2, Q-3, R-1, S-4
(B) P-3, Q-2, R-4, S-1
(C) P-4, Q-1, R-2, S-3
(D) P-2, Q-1, R-3, S-4

13. Which method is most appropriate and widely recommended for the collection of gunshot residue from a victim's clothing for subsequent Scanning Electron Microscopy (SEM) analysis?
(A) Vigorous mechanical shaking of clothing over a clean sheet of paper
(B) Pressing adhesive carbon stubs directly onto fabric
(C) Washing the fabric in distilled water and analyzing liquid runoff
(D) Cutting the fabric into microscopic pieces and burning the material

14. Which of the following is NOT an acceptable precaution when collecting gunshot residue samples at a crime scene?
(A) Using disposable gloves and changing them between subjects
(B) Allowing the suspect to wash their hands prior to sampling to remove non-GSR dirt
(C) Capping adhesive stubs immediately after sampling to prevent environmental contamination
(D) Sampling the suspect's hands before transporting them in a police vehicle

15. The Dermal Nitrate test (Paraffin test) is largely considered obsolete in modern forensic science because it yields false positives in the presence of which of the following everyday substances?
(A) Fertilizers and cosmetics
(B) Common household table salt
(C) Silicon-based synthetic lubricants
(D) Synthetic garment fabric fibers

16. In the Modified Griess test used for distance determination, what color change indicates a positive reaction for the presence of nitrite residues?
(A) Bright blue shade
(B) Emerald green shade
(C) Orange or red
(D) Dark pitch black

17. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): In the Sodium Rhodizonate test, the presence of lead is indicated by a pinkish-red color which turns blue-violet upon the addition of 5% Hydrochloric acid.
Reason (R): Hydrochloric acid chemically reacts with barium to produce a blue-violet complex, confirming the presence of both lead and barium simultaneously.
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(B) Both Assertion (A) and Reason (R) are true

Click Here to Buy book on Flipkart

the exit side

Which of the following represents the correct sequence?

(A) 2, 3, 4, 1
(B) 2, 4, 3, 1
(C) 1, 2, 3, 4
(D) 2, 1, 3, 4

35. When a bullet strikes a rigid metal surface, such as a car door, at an acute angle, the resulting bullet hole will typically exhibit:

(A) Perfectly symmetrical circular deformation across the entire surface
(B) A pinch point on entry and an elongated wipe toward exit
(C) A prominent splash ring of melted metal distributed uniformly around the impact hole
(D) Immediate catastrophic shattering of the sheet metal into microscopic shards

36. Match the target material in List I with its characteristic bullet impact feature in List II:

List I: (Target Material)
P. Window Glass
Q. Human Skin
R. Woven Fabric
S. Sheet Metal

List II: (Impact Feature)
1. Abrasion collar and dirt ring
2. Radial and concentric fractures
3. Pinch point and paint transfer
4. Fiber melting and bullet wipe

(A) P-2, Q-1, R-4, S-3
(B) P-1, Q-2, R-3, S-4
(C) P-4, Q-3, R-2, S-1
(D) P-2, Q-4, R-1, S-3

37. In a room where multiple bullet trajectories have been identified and mapped using strings or lasers, the determination of the shooter's position is primarily found by locating:

(A) The convergence point of the trajectory lines (point of origin)
(B) The specific spatial point where the mapped trajectory lines are furthest apart
(C) The absolute lowest geometric point of the trajectory path recorded on the floor
(D) The single largest and most damaged bullet impact hole identified in the wall

38. Consider the following steps used to sequence multiple bullet holes in a single pane of glass:

1. Examine the termination points of the radial fracture lines.
2. Identify the separate impact sites and their respective radial fractures.
3. Determine that the fracture lines from a subsequent shot stop at the pre-existing fracture lines of an earlier shot.
4. Establish the chronological order of the shots based on fracture intersections.

Which of the following represents the correct sequence?

(A) 2, 1, 3, 4
(B) 1, 2, 3, 4
(C) 3, 1, 2, 4
(D) 2, 3, 1, 4

NODIA

39. Modern trajectory analysis often utilizes 3D laser scanning software to create digital crime scene reconstructions. These scanners typically map the scene by generating a vast collection of precise data points known as a:

(A) Point cloud
(B) Vector polygon
(C) Raster image
(D) Digital elevation model

40. Consider the following elements utilized in shooting incident reconstruction:

I. Autopsy reports detailing wound tracks in the victim
II. Trajectory angles measured from bullet holes in walls
III. Gunshot residue patterns on the victim's clothing

Which of the above data sources are typically integrated to scientifically reconstruct a shooting event?

(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

41. Match the historical and modern primer mix components in List I with their functional roles in List II:

List I: (Primer Component)
P. Lead styphnate
Q. Barium nitrate
R. Antimony sulfide
S. Tetracene

List II: (Functional Role)
1. Oxidizer
2. Frictionator / Sensitizer
3. Fuel
4. Primary explosive

(A) Intermediate range (approx. 2 to 3 feet)
(B) Distant range (beyond 4 feet)
(C) Contact or near-contact range
(D) Indeterminate range

27. To accurately determine the distance from which a firearm was discharged by comparing GSR patterns, a forensic ballistics expert conducting test firings must use:
(A) A firearm of the same caliber, but the exact weapon is not required
(B) The exact suspect weapon, but any standard ammunition of that caliber
(C) Any firearm and any ammunition, provided they are fired in the same weather conditions
(D) The exact suspect weapon and ammunition of the same make, model, and batch

28. In forensic ballistics, which statement best defines the term "bullet trajectory" in a shooting incident?
(A) The path of a projectile from the firearm muzzle to the impact point
(B) The rotational gyroscopic speed of the bullet inside the rifled barrel
(C) The chemical reaction sequence occurring inside the cartridge case upon firing
(D) The total kinetic energy transferred to the target tissue upon bullet impact

29. When searching for latent or obscured bullet holes on dark clothing, which of the following techniques is most effective for visualizing the invisible lead wipe or gunshot residue?
(A) Soaking the affected garment in a concentrated bleach chemical solution
(B) Ultraviolet (UV) light or Infrared (IR) photography
(C) Dusting the fabric heavily with dark black latent fingerprint powder
(D) Washing the entire garment in warm soapy water and laundry detergent

30. A forensic scientist measures a bullet hole in a sheet of drywall. The hole has an elliptical shape with a width (minor axis) of 10 mm and a length (major axis) of 20 mm. Using the standard formula [$\sin(\theta)$ = width/length], what is the estimated angle of impact?
(A) 15 degrees
(B) 30 degrees
(C) 45 degrees
(D) 60 degrees

31. Which of the following is a critical procedural guideline when using trajectory rods to determine the flight path of a bullet through a surface?
(A) Rods must be inserted gently to avoid damaging the margins of the bullet hole.
(B) Rods should be driven forcefully into the bullet hole to ensure they are fully seated deeply.
(C) Rods must be coated completely in heavy mechanical oil prior to insertion into any aperture.
(D) Rods are useful exclusively for perfectly circular bullet holes and never for elliptical defects.

32. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): In crime scene reconstruction, lasers are often preferred over physical stringing for illustrating long-distance bullet trajectories.
Reason (R): Physical strings tend to sag over long distances due to gravity, which can introduce significant errors in angle measurement.
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(B) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

NODIA

33. When photographically documenting a bullet trajectory using lasers at a crime scene, which technique is standard practice to make the laser beam visible in the photographs?
(A) Attaching a specialized polarizing optical lens filter directly to the camera
(B) Shining a high-intensity white light source directly into the primary camera lens
(C) Coating the external laser housing unit with bright fluorescent fingerprint powder
(D) Applying aerosol smoke or working in low-light conditions

34. Arrange the sequence of events that occur when a bullet strikes a standard pane of window glass:
1. Formation of concentric fractures on the entry side
2. Initial impact and stress on the glass surface
3. Bending and bulging of the glass on the exit side
4. Formation of radial fractures originating on

(B) Horizontal azimuth angle relative to baseline
(C) Rotational gyroscopic twist of the bullet
(D) Maximum depth of the bullet penetration path

70. In trajectory analysis, the angle measured on the horizontal plane (side-to-side) relative to a zero reference line is called the:
(A) Zenith angle
(B) Deflection angle
(C) Azimuth angle
(D) Elevation angle

71. The dark ring consisting of soot, lubricant, primer residue, and bullet metal transferred to the margins of an entry hole in fabric or skin is formally known as:
(A) Bullet wipe
(B) Stippling
(C) Tattooing
(D) Cylinder flare

72. When analyzing a bullet hole in a glass window to determine the direction of fire, forensic experts look at the cross-sectional edge of the radial fractures. Which pattern rule is applied here?
(A) The 2R rule (Radial cracks form a Right angle on the Reverse side of the force)
(B) The 4R rule
(C) The concentric rule
(D) The 3R rule (Radial cracks form a Right angle on the Reverse side of the force)

73. When a bullet passes through the flat bone of a human skull, the shape of the resulting hole can indicate the direction of travel. Which of the following statements is true regarding this characteristic?
(A) The hole on the entry side is significantly wider and heavily beveled, whereas the exit side remains narrow.
(B) Entry hole is cleanly punched and narrow; exit hole is wider and beveled.
(C) The hole exhibits a perfectly uniform circular diameter and structure on both internal and external sides.
(D) Bone fracture patterns in flat cranial structures never reliably reveal the direction of a bullet track.

74. If a bullet passes through a synthetic fabric like polyester at a very high velocity, what physical trace is often left on the fabric margins besides gunshot residue?
(A) Complete chemical bleaching of the natural or synthetic fabric color
(B) Immediate rapid structural crystallization of the surrounding fibers
(C) Microscopic melting of synthetic fibers from friction
(D) Heavy localized water condensation rings forming around fabric margins

75. In forensic photography of dark, blood-stained clothing, which wavelength is heavily utilized to visualize obscured soot and bullet wipe around a suspected entry hole?
(A) X-ray wavelengths
(B) Shortwave Ultraviolet
(C) Microwave
(D) Infrared

76. During an autopsy of a shooting victim, fragments of shattered rib bone are driven forward by the bullet, causing independent damage to the heart and lungs. These bone fragments act as:
(A) Secondary missiles
(B) Primary projectiles
(C) Propellant residues
(D) Ricochet elements

77. When 3D mapping a crime scene for trajectory reconstruction, forensic scientists often plot points using a system of X, Y, and Z axes. This mathematical framework is known as the:
(A) Spherical coordinate system
(B) Cartesian coordinate system
(C) Polar coordinate system
(D) Logarithmic coordinate system

78. Which international organization sets the most widely recognized standard guide for gunshot residue (GSR) analysis by SEM-EDX?
(A) WHO (World Health Organization)
(B) ASTM International
(C) Interpol
(D) United Nations

79. When an expert testifies that the GSR found on a suspect "is consistent with" the discharge of a firearm, they legally imply that:
(A) Findings match expected weapon firing, though other sources are possible.
(B) The suspect is undoubtedly guilty of committing the offense of murder beyond reasonable doubt.
(C) The detected GSR definitely originated from the exact specific firearm recovered at the

Downloaded from www.pdf.tube

(A) P-4, Q-1, R-3, S-2
(B) P-1, Q-4, R-2, S-3
(C) P-4, Q-3, R-1, S-2
(D) P-2, Q-1, R-4, S-3

42. Select the correct standard sequence for processing a shooting scene involving trajectory analysis:
(A) Insert trajectory rods → Secure scene → Photograph → Locate bullet holes → Measure angles
(B) Locate bullet holes → Measure angles → Secure scene → Photograph → Insert trajectory rods
(C) Secure scene → Photograph → Locate bullet holes → Insert trajectory rods → Measure angles
(D) Photograph → Secure scene → Insert trajectory rods → Locate bullet holes → Measure angles

43. Match the instrumental technique in List I with its primary forensic characteristic in List II:
List I: (Instrumental Technique)
P. SEM-EDX
Q. Atomic Absorption Spectroscopy (AAS)
R. Neutron Activation Analysis (NAA)
S. Inductively Coupled Plasma Mass Spectrometry (ICP-MS)
List II: (Forensic Characteristic)
1. Excellent for Ba and Sb, poor for Pb, requires a nuclear reactor
2. Non-destructive, provides both morphological and elemental data
3. Destructive bulk analysis, analyzes one element at a time via light absorption
4. Highly sensitive multi-element bulk analysis, requires ionizing a sample in argon gas
(A) P-2, Q-3, R-1, S-4
(B) P-1, Q-2, R-4, S-3
(C) P-3, Q-1, R-2, S-4
(D) P-2, Q-4, R-3, S-1

44. Select the correct sequence of chemical testing when examining a victim's clothing for distance determination (from least destructive to most specific):
(A) Visual/Microscopic exam → Sodium Rhodizonate Test → Modified Griess Test → Dithiooxamide Test
(B) Visual/Microscopic exam → Modified Griess Test → Dithiooxamide Test → Sodium Rhodizonate Test
(C) Sodium Rhodizonate Test → Modified Griess Test → Visual/Microscopic exam → Dithiooxamide Test
(D) Modified Griess Test → Visual/Microscopic exam → Sodium Rhodizonate Test → Dithiooxamide Test

45. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): SEM-EDX is vastly preferred over Atomic Absorption Spectroscopy (AAS) for presenting gunshot residue evidence in court.
Reason (R): SEM-EDX analysis is non-destructive, leaving the unique GSR particles physically intact for re-examination by opposing experts, whereas AAS destroys the sample.
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(B) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

NODIA

46. Consider the following statements relating to ballistics and trajectory:
I. Internal ballistics studies the projectile's behavior from the time the primer ignites to the time it exits the muzzle.
II. External ballistics focuses on the projectile's flight path from the muzzle to the target.
III. Terminal ballistics analyzes the interaction of the projectile with the target material.
IV. Trajectory analysis at a crime scene relies exclusively on internal ballistics data.
Which of the above statement(s) is/are correct?
(A) I, II, and III
(B) I, II, and IV
(C) II, III, and IV
(D) I, III, and IV

47. Consider the following phenomena in trajectory analysis:
I. Deflection occurs when a bullet strikes a surface and penetrates it, but its path angle changes as it moves through the material.
II. Ricochet occurs when a bullet strikes a surface and bounces off rather than penetrating it entirely.
III. The critical angle for ricochet remains exactly the same regardless of the target material (e.g., concrete vs. water).
Which of the above statement(s) is/are correct?

(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

48. Compounds such as centralite and diphenylamine found in gunshot residue are best classified as:
(A) Inorganic primer constituents
(B) Metallic bullet jacket fragments
(C) Organic propellant stabilizers
(D) Corrosive barrel lubricants

49. In the context of older, corrosive ammunition, which compound was notoriously used in primers, leading to significant barrel rusting if not cleaned?
(A) Mercury fulminate salt
(B) Metallic lead azide compound
(C) Insoluble barium sulfate
(D) Potassium chlorate

50. During the Dermal Nitrate test, the Lunge reagent is used. What is the active chemical in the Lunge reagent that reacts with nitrates?
(A) Aqueous sodium rhodizonate solution
(B) Concentrated sulfanilic acid reagent
(C) Diphenylamine in sulfuric acid
(D) Pure alpha-naphthylamine compound

51. In a typical modern centerfire primer mixture, what is the primary role of Barium nitrate?
(A) It serves as the primary impact-sensitive explosive component of the mixture.
(B) It acts as an oxidizer supplying oxygen for the reaction.
(C) It functions primarily as a mechanical frictionator to generate required heat.
(D) It is added purely to stabilize the chemical mixture during long-term storage.

52. In a typical modern centerfire primer mixture, what is the primary role of Antimony sulfide?
(A) Oxidizer
(B) Primary explosive
(C) Lubricant
(D) Fuel

53. Which of the following is the most sensitive primary explosive utilized in standard lead-based percussion primers today?
(A) Lead styphnate
(B) TNT
(C) RDX
(D) Ammonium nitrate

54. A known false positive for the diphenylamine test occurs frequently when an individual has recently handled:
(A) Commercial glass containers
(B) Insulated copper wiring
(C) Fertilizers
(D) Standard plastic packaging

55. To prepare the photographic paper for the Modified Griess test, the paper must first be:
(A) Fixed in standard photographic hypo solution to desensitize it
(B) Exposed directly to bright, intense natural sunlight for a full 24 hours
(C) Coated completely in a heavy, thick layer of fine metallic lead powder
(D) Fully soaked in a bath of concentrated hydrochloric acid solution

56. What is the standard pH of the tartrate buffer solution utilized to optimize the color change in the Sodium Rhodizonate test?
(A) pH 1.0
(B) pH 2.8
(C) pH 7.0
(D) pH 10.5

57. During the Harrison and Gilroy test, after detecting antimony, a secondary step involving the addition of sodium rhodizonate can be used. This secondary step confirms the presence of:
(A) Zinc and Copper
(B) Lead and Barium
(C) Nitrates and Nitrites
(D) Carbon and Sulfur

58. When deciding between swabbing and using adhesive stubs for GSR collection from a suspect's hands, why are adhesive stubs generally preferred in modern forensic laboratories?
(A) Stubs are significantly cheaper and simpler to mass-manufacture than standard cotton swabs.
(B) Stubs can be processed and analyzed via AAS instrumental methods, whereas swabs cannot.
(C) Stubs fit directly into the SEM chamber without chemical extraction.
(D) Stubs instantly change color at the physical crime scene if any GSR particles are present.

59. What is the base material typically used on the adhesive surface of a standard GSR collection stub designed for SEM-EDX?

Click Here to Buy book on Amazon

(A) High-purity adhesive copper tape
(B) Clear plastic cellophane film
(C) Standard commercial masking tape
(D) Conductive carbon tape

60. First responders to a shooting scene must be careful not to touch the suspect's hands primarily to avoid:
(A) Transferring occupational GSR from their duty weapons to the suspect
(B) Completely destroying fragile latent friction ridge fingerprints on the palms
(C) Unintentionally causing the suspect unnecessary severe physical pain or injury
(D) Accelerating the environmental chemical breakdown of fragile GSR particles

61. If a victim's clothing is heavily saturated with fresh blood at a shooting scene, what is the most appropriate action before packaging the clothing for GSR distance determination analysis?
(A) Thoroughly wash the garment in cold water to remove blood so GSR is clearly visible.
(B) Air-dry clothing at room temperature on clean paper, then bag in paper.
(C) Package the clothing tightly inside a sealed plastic bag while still wet to preserve moisture.
(D) Apply a hot iron directly to the clothing on high heat to rapidly dry all blood saturation.

62. In SEM-EDX analysis, what physical phenomenon provides the elemental composition of the gunshot residue particle?
(A) The selective absorption of ultraviolet light frequencies by present metallic elements
(B) Emission of characteristic X-rays upon electron beam bombardment
(C) The immediate visible color change of the particle under high optical magnification
(D) The spontaneous nuclear radioactive decay of volatile metallic isotopes in the primer

63. What does the acronym EDX stand for in the context of forensic instrumental analysis?
(A) Energy Dispersive X-ray
(B) Electron Deposition X-ray Analysis
(C) Elemental Diffraction X-ray Method
(D) Energy Detection Xenon-spectroscopy

64. The principle of Atomic Absorption Spectroscopy (AAS) relies upon:
(A) The physical scattering of a focused laser beam by solid suspended target particles
(B) The thermal emission of visible light frequencies from heated molecular chemical bonds
(C) Light absorption by free, unexcited ground-state atoms
(D) The nuclear magnetic resonance response generated by atomic nuclei in a magnetic field

65. Which instrumental method offers extreme sensitivity capable of detecting trace elements at parts-per-trillion levels by ionizing the sample in argon plasma and separating ions by their mass-to-charge ratio?
(A) SEM-EDX
(B) AAS
(C) FTIR
(D) ICP-MS

66. When evaluating a shotgun impact pattern, what is the general forensic rule of thumb regarding the spread of the shot pellets in relation to the distance from the muzzle to the target?
(A) The pattern spreads approximately 1 foot for every 1 yard of distance.
(B) The pattern spreads exactly 5 inches regardless of distance.
(C) The pattern spreads approximately 1 inch for every 1 yard of distance.
(D) Shot pellets do not spread; they strike as a single mass at all distances.

NODIA

67. The phenomenon where a bullet tumbles or destabilizes upon entering a dense medium like tissue or ballistics gel is known as:
(A) Ricochet
(B) Yaw
(C) Spalling
(D) Mushrooming

68. A plumb bob is primarily utilized in crime scene trajectory analysis to:
(A) Measure the precise horizontal azimuth angle relative to the reference wall
(B) Determine the exact physical caliber dimensions of the bullet impact hole
(C) Chemically test the bullet wipe margins around the impact defect for lead
(D) Provide a vertical reference line for angle measurements

69. When documenting trajectory angles, an inclinometer is specifically used to measure the:
(A) Vertical elevation or depression angle

CHAPTER 29
Gunshot Residue and Trajectory Analysis

1. What is the most accurate definition of gunshot residue (GSR) in forensic science?
(A) Only the unburnt propellant powder expelled from the muzzle of a firearm
(B) The microscopic metallic shavings left exclusively inside the barrel of a firearm
(C) The soot deposit found strictly on the hands of the person who discharged the weapon
(D) The plume of vaporous and particulate material discharged from a firearm upon firing

2. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Gunshot residue particles typically exhibit a spherical or nodular morphology under an electron microscope.
Reason (R): The high temperature and pressure of firing vaporize the primer mixture, which rapidly condenses into droplets upon sudden cooling in the air.
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(B) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

3. Which of the following compounds is a primary organic constituent of gunshot residue originating from modern smokeless propellant?
(A) Barium nitrate
(B) Nitrocellulose
(C) Lead styphnate
(D) Antimony sulfide

4. The classic inorganic triad of elements highly characteristic of modern gunshot residue primer particles consists of which of the following?
(A) Lead, Copper, and Zinc
(B) Barium, Strontium, and Magnesium
(C) Antimony, Copper, and Iron
(D) Lead, Barium, and Antimony

5. Consider the following statements regarding the characteristics of gunshot residue (GSR):
I. Primer residues are mostly inorganic in nature.
II. Propellant residues are mostly organic in nature.
III. The primer mixture contains an initiator, an oxidizer, and a fuel.
IV. Organic GSR cannot be detected using any modern instrumental technique.
Which of the above statement(s) is/are correct?
(A) I, II, and III
(B) I, II, and IV
(C) II, III, and IV
(D) I, III, and IV

6. Modern lead-free and non-toxic primers, such as Sintox ammunition, commonly utilize which of the following compounds as the primary explosive instead of lead styphnate?
(A) Mercury fulminate salt
(B) Potassium perchlorate
(C) Diazodinitrophenol
(D) Barium peroxide powder

7. Which factor most heavily dictates the physical shape and spatial distribution of the gunshot residue plume emitted from a firearm?
(A) The barrel length and type of the firearm
(B) The specific age of the shooter
(C) The color of the clothing worn by the victim
(D) The physical material of the trigger mechanism

8. Consider the following factors:
I. Wind direction and velocity at the crime scene.
II. The caliber and type of ammunition used.
III. The blood group of the victim.
Which of the above factors significantly affect the deposition of gunshot residue on a target?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

Downloaded from www.pdf.tube

crime scene.
(D) The suspect personally discharged the firearm within a maximum of ten minutes prior to sampling.

80. Under the Bharatiya Sakshya Adhiniyam, 2023, the opinion of a forensic ballistics expert regarding gunshot residue and trajectory is admissible in a court of law under which specific section?
(A) Section 25
(B) Section 39
(C) Section 50
(D) Section 164

81. The ultimate goal of integrating GSR distance determination, bullet trajectory analysis, and autopsy findings in a forensic report is to:
(A) Determine the exact commercial brand and manufacturer of clothing worn by the victim
(B) Completely bypass the requirement for a formal judicial court trial entirely
(C) Guarantee a definitive criminal conviction for the prosecution team in court
(D) Corroborate witness statements and reconstruct event sequence

82. Which common household or occupational item is well documented in forensic literature as containing high levels of Barium and Antimony, potentially causing false positives in elemental GSR screening if morphological analysis is not performed?
(A) Household aluminum foil packaging
(B) Commercial glass cleaner spray
(C) Automotive brake pads
(D) Standard printer ink cartridges

83. The Walker Test for nitrites on clothing utilizes which pair of chemical reagents to produce the characteristic orange-red color?
(A) Diphenylamine and sulfuric acid
(B) Sulfanilic acid and alpha-naphthylamine
(C) Sodium rhodizonate and hydrochloric acid
(D) Triphenylmethylarsonium iodide and acetone

84. When evaluating the persistence of GSR on hands, which daily human activity is most responsible for the rapid, mechanical loss of these particles?
(A) Normal deep physiological breathing by the individual
(B) Continuous direct ambient exposure to natural sunlight
(C) Passive profuse sweating without touching any physical surface
(D) Hand washing, wiping hands, and normal friction

85. If a shooting occurred entirely outdoors in heavy, torrential rain, a forensic investigator would expect the GSR deposition on the victim's clothing to be:
(A) Significantly washed away or distorted
(B) Perfectly preserved and crystallized
(C) Unaffected, as GSR is completely waterproof
(D) Chemically transformed into metallic lead sheets

86. During a crime scene investigation, a scientific team must secure a suspect's hands for later gunshot residue (GSR) sampling at the police station. What is the correct method to preserve the evidence during transport?
(A) Tightly wrap both of the suspect's hands inside sealed plastic bags
(B) Handcuff the suspect while thoroughly soaking their hands in bleach
(C) Wrap suspect's hands in paper bags secured at wrists
(D) Instruct the suspect to keep their hands firmly placed inside pockets

NODIA

87. In internal ballistics, what is the primary function of the "anvil" within a centerfire cartridge primer?
(A) It provides a rigid surface to crush the primer mixture upon impact.
(B) It rapidly cools down hot expanding gases prior to their entry into the barrel.
(C) It hermetically seals the cartridge case opening to prevent environmental water entry.
(D) It physically aligns and guides the bullet directly into the rifled barrel lands.

88. When measuring a bullet hole in a wooden door, the expert notes that the wood is splintered outward on one specific side. In forensic trajectory, this outward splintering characterizes the:
(A) Entry side of the bullet
(B) Exact midpoint of the door
(C) Point of maximum velocity
(D) Exit side of the bullet

9. (B) 4 to 6 hours
Gunshot residue deposited on bare skin adheres loosely through weak physical surface forces. Routine physical activities, hand movements, friction against clothing, and natural skin shedding rapidly dislodge these microscopic particles. In active living individuals, most recoverable residue is lost within four to six hours, making prompt sampling critical for reliable forensic collection before background noise predominates.

10. (C) Transfer of GSR from a fired weapon or contaminated surface to a person's hands
Secondary transfer occurs when an individual acquires gunshot residue without personally discharging a firearm. This indirect deposition happens through physical contact with contaminated surfaces, such as handling a recently fired weapon, touching a shooter's clothing, or sitting in police vehicles containing residual particulates. Recognizing secondary transfer is essential when evaluating the forensic significance of detected particles.

11. (D) 5% Nitric acid or hydrochloric acid
Swabbing hands for elemental gunshot residue requires a mild acid solution to dissolve and solubilize heavy metals like lead, barium, and antimony from skin surfaces. A dilute solution of five percent nitric acid or hydrochloric acid efficiently extracts metallic ions without causing severe skin irritation, preparing the extracted sample for bulk elemental analysis through spectroscopic instrumental techniques.

12. (A) P-2, Q-3, R-1, S-4
The Modified Griess test specifically targets nitrite ions originating from partially burnt propellant powder. Sodium rhodizonate reacts with heavy metals, yielding color changes for lead and barium. The Harrison and Gilroy test uses triphenylmethylarsonium iodide to detect antimony. Diphenylamine serves as a general reagent reacting with both nitrates and nitrites, providing broad chemical screening for organic residues.

13. (B) Pressing adhesive carbon stubs directly onto fabric
Adhesive carbon stubs provide the most effective method for collecting gunshot residue from fabric for electron microscopy. Pressing stubs directly against clothing lifts intact microscopic particles while preserving their original spherical morphology and spatial distribution. Liquid washing or mechanical shaking damages or dislodges delicate particles, while carbon stubs fit directly into instrument sample chambers for immediate examination.

14. (B) Allowing the suspect to wash their hands prior to sampling to remove non-GSR dirt
Hand washing mechanically removes loosely bound microscopic gunshot residue particles from skin through water flow, soap surfactant action, and physical friction. Allowing a suspect to wash their hands before sampling destroys fragile trace evidence and invalidates forensic analysis. Scene protocols require immediate sampling or securing hands in breathable paper bags to prevent loss or secondary contamination during transport.

15. (A) Fertilizers and cosmetics
The dermal nitrate test relies on diphenylamine reacting with nitrates to produce a blue color. Nitrates are abundant in everyday environmental sources, including agricultural fertilizers, pharmaceuticals, urine, tobacco, match heads, and cosmetics. Because these common substances yield identical positive reactions, the paraffin test lacks specificity for firearm discharge residues and has been replaced by advanced elemental testing.

16. (C) Orange or red
The Modified Griess test detects nitrite particles produced during incomplete propellant combustion. When sulfanilic acid and alpha-naphthylamine react with nitrites under acidic conditions, a diazotization reaction occurs. This chemical sequence produces an azo dye, forming distinct orange or red spots on treated photographic paper, corresponding precisely to the spatial distribution of burnt powder residues around an impact hole.

17. (C) Assertion (A) is true but Reason (R) is false.
Sodium rhodizonate reacts with lead ions at pH 2.8 to produce a pinkish-red complex. Adding five percent hydrochloric acid converts this complex into a blue-violet color, confirming lead presence. Hydrochloric acid clears background interference from other metal complexes rather than forming a blue-violet complex with barium, making the explanatory reasoning chemically incorrect despite the initial assertion being accurate.

Click Here to Buy book on Flipkart

STUDYING FROM PDFs?

THINK AGAIN.

If you are studying only from PDFs,
you are wasting valuable time.

Research shows that learning from

PRINTED BOOKS has up to

4× HIGHER RETENTION

than studying from screens.

PRINT BOOK = BETTER MEMORY

PDF = LOWER RETENTION

Those who study from **PRINTED BOOKS**
move **AHEAD.**

Others are left **BEHIND**
in competition.

In competitive exams,
being average is not enough.

STAY ONE STEP AHEAD.

ANSWERS

1. (D) The plume of vaporous and particulate material discharged from a firearm upon firing
Gunshot residue encompasses all materials released through the discharge of a firearm. Upon firing, the rapid combustion of propellant powder and ignition of the primer mixture create a complex cloud containing gaseous, vaporous, and solid microscopic particulate matter. This plume expands outward from the muzzle and cylinder gaps, depositing residues onto surrounding surfaces and hands.

2. (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
During firearm discharge, extreme temperatures and pressures vaporize metallic components within the primer mixture. As these gaseous metallic species are expelled into ambient air, rapid cooling causes them to condense into microscopic liquid droplets. Surface tension draws these condensing droplets into characteristic spherical or nodular morphologies, which solidify before settling onto nearby surfaces, making morphology central to identification.

3. (B) Nitrocellulose
Modern smokeless propellants predominantly rely on nitrocellulose as their primary organic constituent. Single-base propellants consist almost entirely of nitrocellulose, whereas double-base formulations combine nitrocellulose with nitroglycerin to enhance energy output. During firearm discharge, incomplete combustion leaves unburnt and partially burnt propellant granules containing nitrocellulose, serving as key organic markers for chemical analysis in forensic ballistics investigations.

4. (D) Lead, Barium, and Antimony
Standard primers utilized in modern small arms ammunition contain a primary explosive mix composed of lead styphnate, barium nitrate, and antimony sulfide. Upon mechanical percussion, these chemical compounds react rapidly, releasing elemental lead, barium, and antimony. The simultaneous presence of these three elements in fused microscopic particles forms the classic inorganic elemental triad characteristic of gunshot residue.

5. (A) I, II, and III
Primer residues consist mainly of inorganic heavy metals like lead, barium, and antimony, whereas propellant residues are organic compounds such as nitrocellulose. Primer formulations require an initiator, an oxidizer, and a fuel to function effectively. Modern analytical techniques like liquid chromatography and mass spectrometry readily detect organic gunshot residues, making statements regarding non-detectability completely false in current practice.

6. (C) Diazodinitrophenol
Non-toxic and heavy-metal-free ammunition formulations, such as Sintox, eliminate toxic lead, barium, and antimony to reduce environmental hazards. These modern primers replace traditional lead styphnate with organic primary explosives like diazodinitrophenol. Diazodinitrophenol provides necessary impact sensitivity without generating lead-containing vapor or heavy metal particulate residues during the high-pressure ignition cycle inside the firearm primer cap.

7. (A) The barrel length and type of the firearm
The physical shape, velocity, and spatial dispersion of a gunshot residue plume are governed by the mechanical features of the firearm. Shorter barrels allow gases to expand more broadly near the muzzle, while longer barrels confine gases, narrowing the plume. Cylinder gaps in revolvers also release secondary plumes, altering the overall spatial deposition pattern surrounding the shooter.

8. (A) I and II only
Environmental conditions such as wind velocity and direction actively divert airborne residue plumes during firing, altering deposition patterns on target surfaces. Ammunition caliber, powder charge, and barrel characteristics dictate the initial volume and momentum of expelled particles. Biological traits of the victim, including blood group, exert no influence whatsoever on the physical flight or settling of residue particles.

Downloaded from www.pdf.tube

89. A "keyhole" shaped bullet wound or defect typically occurs when the bullet:
(A) Enters the target perfectly straight at maximum velocity
(B) Strikes the target while yawing or tumbling sideways
(C) Explodes inside the barrel before exiting
(D) Melts completely before reaching the target

90. Which of the following best describes the principle of Locard's Exchange Theory as it applies to gunshot residue analysis?
(A) Expelled GSR particles will strictly travel along an undeviated linear path within a vacuum.
(B) Projectile bullets exchanged between two separate firearms will merge physical striation marks.
(C) Shooting deposits GSR onto surroundings while transferring residues to the shooter.
(D) Strictly organic propellant residues can be physically transferred between a firearm and shooter.

NODIA

18. (C) Antimony
The Harrison and Gilroy chemical reagent scheme employs triphenylmethylarsonium iodide to selectively detect antimony in firearm discharge residues. Upon reacting with antimony ions under acidic conditions, the reagent forms an orange-red iodide complex. This color reaction allows rapid screening of swabs prior to confirmatory micro-analytical or elemental spectroscopy methods in forensic laboratory workflows.

19. (B) Partially burnt powder (Nitrites)
The Walker test represents an early photographic paper technique designed to visualize pattern distributions of partially burnt smokeless powder grains on target garments. It specifically detects nitrite ions generated during incomplete propellant combustion. Nitrites react with sulfanilic acid and alpha-naphthylamine, transferring red-orange dye patterns onto desensitized photographic paper to assist in distance determination investigations.

20. (D) AAS provides bulk elemental analysis without revealing particle morphology
Atomic absorption spectroscopy requires dissolving collected residues in acid solutions to measure elemental quantities in bulk. While highly sensitive to metal concentrations, this destructive liquid extraction completely destroys particle morphology. Unlike electron microscopy, atomic spectroscopy cannot confirm whether detected lead, barium, and antimony existed as single, fused, spherical gunshot residue particles or derived from separate environmental sources.

21. (A) Lead
Neutron activation analysis operates by bombarding sample materials with neutrons inside a nuclear reactor, creating radioactive isotopes whose decay gamma rays are measured. While exceptionally sensitive for detecting barium and antimony, this technique is ineffective for lead analysis due to the nuclear properties and short half-life of lead isotopes produced, necessitating complementary methods for complete triad detection.

22. (B) II and III only
Scanning electron microscopy coupled with energy dispersive X-ray spectroscopy offers non-destructive analysis of gunshot residue. It simultaneously evaluates three-dimensional particle morphology and multi-element chemical composition on individual particles. Because it identifies single, fused spherical particles containing lead, barium, and antimony, it serves as the definitive gold standard for conclusive forensic residue identification in modern ballistics laboratories.

23. (A) Spheroidal or nodular
Inorganic gunshot residue particles form when vaporized metals rapidly cool and condense in air after firearm discharge. Surface tension during molten condensation forces particles into characteristic spheroidal, spherical, or smooth nodular shapes ranging from sub-micron to several micrometers in size. This distinctive smooth, rounded morphology helps distinguish true firearm residues from angular, crystalline environmental metallic dust particles.

24. (D) The suspect discharged a firearm, was near a firing weapon, or touched a GSR-bearing item.
Detecting characteristic three-component residue particles confirms exposure to firearm discharge materials but cannot identify the specific role of an individual. Forensic experts must state neutrally that findings indicate the subject fired a weapon, stood near a discharging firearm, or made physical contact with a contaminated surface, as physical transfers produce identical microscopic particulate signatures on hands.

25. (D) I, II, III, and IV
Various industrial and commercial sources contain elements common to gunshot residue. Automotive brake pads release barium and antimony, pyrotechnics utilize barium compounds, industrial stud guns fire rimfire cartridges, and lead-acid batteries contain lead and antimony. Without evaluating microscopic spherical morphology through electron microscopy, chemical or elemental screening of these occupational materials can yield deceptive false positives.

26. (C) Contact or near-contact range
A contact or near-contact gunshot produces intense physical effects on target garments. High-pressure expanding gases force soot and unburnt powder directly into fabric fibers, while gas pressure tearing forms characteristic star-shaped or cruciform rips around the entrance defect. Dense, heavy soot blackening coupled with physical fabric destruction indicates the

Click Here to Buy book on Amazon

inspection to specific chemical visualizations. Visual examination documents soot and macro-patterns without altering evidence. The Modified Griess test detects nitrites without interfering with metal deposits. The dithiooxamide test detects copper from bullet jackets, followed finally by the sodium rhodizonate test to visualize lead distributions around defects.

45. (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
SEM-EDX analysis is preferred in legal proceedings because it preserves evidence while delivering high diagnostic specificity. Mounting samples on adhesive stubs allows non-destructive examination of particle shape and composition. Preserving original microscopic particles permits independent re-examination by defense experts, whereas atomic absorption spectroscopy requires dissolving the sample in acid, permanently destroying particle morphology and context.

46. (A) I, II, and III
Ballistics comprises three classic physical domains. Internal ballistics covers bullet motion inside the firearm from ignition to muzzle exit. External ballistics analyzes free flight through atmosphere toward the target. Terminal ballistics evaluates projectile impact dynamics and penetration inside target materials. Trajectory reconstruction draws upon external and terminal ballistics data rather than relying exclusively on internal mechanics.

47. (A) I and II only
Deflection alters a projectile's flight path as it penetrates and passes through target materials, whereas ricochet describes a bullet rebounding off a surface without penetrating completely. The critical ricochet angle depends heavily on surface hardness, projectile velocity, shape, and target elasticity, making the claim of a constant critical angle across different materials completely false.

48. (C) Organic propellant stabilizers
Modern smokeless propellant powders incorporate organic chemical additives to prevent auto-ignition during storage. Compounds like centralite and diphenylamine act as chemical stabilizers by scavenging acidic nitrogen oxide degradation products produced over time. During firing, these organic compounds are expelled alongside unburnt powder grains, serving as key target analytes during organic gunshot residue screening procedures.

49. (D) Potassium chlorate
Older primers utilized potassium chlorate as an oxidizing agent in their chemical mixture. Upon firing, potassium chlorate decomposes into potassium chloride salt deposits inside the barrel. These hygroscopic salt residues attract atmospheric moisture, initiating aggressive oxidation and rapid rusting of steel firearm barrels unless washed thoroughly with aqueous solvent solutions immediately following discharge.

50. (C) Diphenylamine in sulfuric acid
The Lunge reagent utilized in classical dermal nitrate testing consists of diphenylamine dissolved in concentrated sulfuric acid. When applied to nitrates collected from skin or surfaces, sulfuric acid hydrolyzes the nitramines and nitrates, forming nitrating species that oxidize diphenylamine. This chemical interaction produces a intense blue reaction product, indicating the presence of oxidizing nitrate compounds.

51. (B) It acts as an oxidizer supplying oxygen for the reaction.
Barium nitrate functions as a primary inorganic oxidizing agent within modern centerfire primer formulations. Upon impact-induced shock, it rapidly decomposes at high temperatures, liberating gaseous oxygen required to sustain rapid combustion of fuel constituents like antimony sulfide. This intense oxidation produces the high-heat thermal flash necessary to ignite main propellant charges in cartridges.

52. (D) Fuel
Antimony sulfide serves primarily as a chemical fuel in modern primer caps. During percussion ignition, antimony sulfide reacts violently with oxygen liberated by oxidizing agents like barium nitrate. This exothermic reaction generates sustained high temperatures, dense incandescent particles, and hot reaction gases that instantly ignite surrounding propellant grains inside the metallic cartridge case.

53. (A) Lead styphnate
Lead styphnate, chemically known as lead 2,4,6-trinitroresorcinate, is the most widely utilized primary explosive in modern percussion primers. It exhibits high sensitivity to mechanical

NODIA

localized crease or pinch point at initial contact. As the projectile slides across and pierces the metal, contact friction transfers bullet material and lubricant along an elongated path, forming an asymmetrical wipe pattern directed toward the exit side of the defect.

36. (A) P-2, Q-1, R-4, S-3
Impact marks vary across target materials. Glass exhibits characteristic radial and concentric fracture networks under stress. Elastic skin forms an abrasion collar surround with bullet wipe residue. Woven textiles display heat-induced fiber melting alongside dark bullet wipe deposition. Sheet metal displays asymmetrical structural pinch points, scratch marks, and localized paint transfer along the impact margin.

37. (A) The convergence point of the trajectory lines (point of origin)
Mapping multiple trajectory lines back toward their common source reveals spatial relationships inside a shooting scene. By extending linear trajectories from several bullet defects backward, these lines intersect in three-dimensional space. This point of convergence defines the estimated spatial location of the firearm muzzle during discharge, helping investigators establish position vectors for shooter placement.

38. (A) 2, 1, 3, 4
Sequencing multiple impacts on glass relies on fracture propagation behavior. Investigators identify distinct impact locations and track radiating fracture patterns. Radial cracks from subsequent shots travel outward until meeting pre-existing fractures created by earlier impacts, where stress waves terminate. By analyzing which radial lines block others, the chronological order of consecutive bullet strikes is established scientifically.

39. (A) Point cloud
Three-dimensional laser scanners record millions of individual spatial spatial measurements across crime scene surfaces by measuring light flight time. This dense array of precise geometric coordinate measurements forms a digital representation known as a point cloud. Forensic software analyzes point cloud data to model exact physical dimensions, perform trajectory line extension, and generate virtual scene reconstructions.

40. (D) I, II, and III
Comprehensive shooting incident reconstruction requires integrating all physical evidence streams. Wound track angles recorded in autopsy reports provide internal trajectories through the body. Trajectory measurements from physical structure defects establish spatial flight vectors. Distance estimates derived from gunshot residue patterns on clothing establish muzzle-to-target spacing, allowing complete alignment of victim, shooter, and environment.

41. (A) P-4, Q-1, R-3, S-2
Centerfire primers rely on balanced chemical formulations. Lead styphnate acts as the sensitive primary explosive detonated by firing pin impact. Barium nitrate supplies oxygen as an inorganic oxidizer. Antimony sulfide provides fuel, sustaining combustion and increasing heat. Tetracene serves as a sensitizer and frictionator, ensuring reliable ignition under low-energy impact conditions inside the primer cap.

42. (C) Secure scene → Photograph → Locate bullet holes → Insert trajectory rods → Measure angles
Systematic crime scene management follows strict sequential protocols to protect evidence. Responders first secure the scene against unauthorized access, followed by comprehensive photography of pristine conditions. Investigators then locate and document bullet impact defects. Inserting trajectory rods occurs only after initial documentation, allowing accurate measurement of vertical and horizontal spatial trajectory angles without corrupting scene context.

43. (A) P-2, Q-3, R-1, S-4
SEM-EDX provides non-destructive single-particle morphological and elemental identification. Atomic absorption spectroscopy measures individual dissolved metals via light absorption but destroys samples. Neutron activation analysis offers high sensitivity for barium and antimony using nuclear reactors but misses lead. ICP-MS provides ultra-trace multi-element bulk analysis through argon plasma ionization and mass filtering of dissolved solution samples.

44. (B) Visual/Microscopic exam → Modified Griess Test → Dithiooxamide Test → Sodium Rhodizonate Test
Chemical testing of evidence garments progresses sequentially from non-destructive physical

Downloaded from www.pdf.tube

62. (B) Emission of characteristic X-rays upon electron beam bombardment
Energy dispersive X-ray spectroscopy operates by directing a high-energy electron beam onto a sample particle. Beam electrons displace inner-shell electrons from atoms, causing outer-shell electrons to drop into lower energy states. This atomic relaxation releases characteristic X-rays with energy levels unique to specific elements, allowing precise elemental identification of lead, barium, and antimony within individual particles.

63. (A) Energy Dispersive X-ray
The acronym EDX stands for Energy Dispersive X-ray spectroscopy, an analytical technique coupled with scanning electron microscopy. EDX measures the energy spectrum of characteristic X-rays emitted from sample atoms bombarded by focused electron beams. Analyzing X-ray energy peaks provides quantitative and qualitative determination of chemical elements present in microscopic gunshot residue particles down to sub-micron scales.

64. (C) Light absorption by free, unexcited ground-state atoms
Atomic absorption spectroscopy quantifies metallic elements by aspirating dissolved liquid samples into a flame to atomize constituent elements. The resulting cloud of free ground-state atoms absorbs light at specific resonance wavelengths produced by element-specific hollow cathode lamps. The amount of light absorbed correlates directly with element concentration, enabling precise bulk quantitative measurement of lead, barium, or antimony.

65. (D) ICP-MS
Inductively coupled plasma mass spectrometry offers extreme trace element analytical sensitivity. Liquid samples are atomized and ionized inside extremely hot argon plasma. The generated single-charged ions are swept into a high-vacuum quadrupole mass spectrometer that separates species according to their precise mass-to-charge ratios, enabling detection of inorganic gunshot residue constituents down to parts-per-trillion levels.

66. (C) The pattern spreads approximately 1 inch for every 1 yard of distance.
Shotgun pattern dispersion follows an established empirical rule of thumb in forensic ballistics. Unchoked smoothbore shotgun barrels typically produce pellet pattern spreads that expand approximately one inch in diameter for every one yard of distance traveled from muzzle to target surface. This baseline approximation provides preliminary estimates during initial crime scene range evaluations prior to formal testing.

67. (B) Yaw
Yaw refers to the angular deviation of a bullet's longitudinal axis from its true vector of flight. When a spinstabilized bullet transitions from air into denser target media like human tissue or ballistic gelatin, aerodynamic balance changes rapidly. This fluid resistance forces the projectile to pitch, rotate, or tumble sideways, dramatically increasing energy transfer and dynamic tissue disruption along the wound path.

68. (D) Provide a vertical reference line for angle measurements
A plumb bob consists of a suspended weighted mass that aligns precisely with local Earth gravitational pull. In crime scene trajectory mapping, hanging a plumb bob adjacent to impact defects establishes an absolute vertical reference axis. Forensic scientists measure trajectory rod angles relative to this true vertical baseline using protractors or inclinometers to calculate vertical angle components accurately.

NODIA

69. (A) Vertical elevation or depression angle
An inclinometer represents a specialized tool designed to measure structural angles relative to gravity. When placed along a trajectory rod inserted through a bullet defect, the device reads the precise angle of vertical pitch. This measurement indicates whether the projectile traveled along an upward trajectory angle or a downward trajectory angle relative to the horizontal floor plane.

70. (C) Azimuth angle
In trajectory reconstruction, horizontal alignment is expressed through the azimuth angle. Measured within a flat horizontal plane parallel to the floor, the azimuth angle reflects the side-to-side orientation of a projectile path relative to an established zero-reference line, such as a designated room wall. Combined with vertical elevation angles, azimuth fully defines spatial flight lines.

impact and friction, detonating instantly when crushed by a firing pin against the internal primer anvil. This reliable initiation generates the initial spark required to ignite secondary primer components and propellants.

54. (C) Fertilizers
Diphenylamine tests detect strong oxidizing species, primarily nitrates and nitrites. Commercial agricultural fertilizers contain concentrated ammonium nitrate, potassium nitrate, and synthetic nitrogen compounds. Handling fertilizers transfers abundant nitrates to skin surfaces, causing immediate blue false-positive reactions during diphenylamine screening, which severely limits the forensic reliability of this reagent for isolated gunshot residue detection.

55. (A) Fixed in standard photographic hypo solution to desensitize it
Preparing paper for the Modified Griess test requires removing light-sensitive silver halide salts from commercial photographic paper. Soaking the paper in a sodium thiosulfate fixing bath removes silver compounds without affecting gelatin layers. This clearing step desensitizes the paper to light exposure, providing a stable, clean gelatin matrix for absorbing specific color-producing Griess reagents during processing.

56. (B) pH 2.8
The sodium rhodizonate test requires a controlled acidic environment to achieve selective color development for lead ions. Applying a sodium bitartrate buffer maintains the reaction surface at an optimal pH of approximately two point eight. This precise acidity ensures maximum complexation of lead ions while minimizing background interference from other metallic species during physical evidence examination.

57. (B) Lead and Barium
The Harrison and Gilroy scheme employs a multi-step reagent sequence to detect primer metals. After identifying antimony using triphenylmethylarsonium iodide, adding sodium rhodizonate reveals lead through a distinctive red-pink complex. Subsequent addition of hydrochloric acid transforms lead to blue-violet while retaining barium complexes, allowing sequential confirmation of both lead and barium from a single evidence swab.

58. (C) Stubs fit directly into the SEM chamber without chemical extraction.
Adhesive carbon stubs are preferred for gunshot residue collection because they transfer directly from field sampling to instrument stages. Unlike cotton swabs that require acid extraction and sample destruction, stub surfaces hold physical particles intact for direct automated electron microscopic examination, preserving three-dimensional particle morphology and enabling simultaneous elemental analysis without prior chemical processing steps.

59. (D) Conductive carbon tape
Standard collection stubs designed for electron microscopy utilize double-sided conductive carbon tape mounted on aluminum pedestals. Conductive carbon provides a firm adhesive matrix that traps microscopic particles upon surface contact. Furthermore, its electrical conductivity prevents electrical charge buildup under focused electron beam bombardment inside the microscope chamber, ensuring high-resolution imaging and accurate elemental X-ray analysis.

60. (A) Transferring occupational GSR from their duty weapons to the suspect
Law enforcement officers carry sidearms and frequent shooting ranges, often accumulating trace gunshot residue on their hands and equipment. Direct physical contact between ungloved officers and suspects risks transferring occupational metallic particles onto the subject's skin. This cross-contamination corrupts evidence, making it impossible to determine whether detected residue resulted from crime scene weapon discharge or secondary transport.

61. (B) Air-dry clothing at room temperature on clean paper, then bag in paper.
Garments saturated with liquid blood present mold and putrefaction risks that ruin physical evidence. Wet clothing must be laid flat on clean paper and allowed to air-dry naturally at room temperature. Direct washing removes particulate residue, heating destroys organic materials, and sealing wet items in plastic encourages fungal growth, making passive paper-supported air-drying essential before paper packaging.

Click Here to Buy book on Flipkart

muzzle was pressed against or held extremely close to skin or fabric.

27. (D) The exact suspect weapon and ammunition of the same make, model, and batch
Accurate firearm distance determination requires replicating original firing conditions closely. Variations in barrel length, wear, choke, powder formulation, and bullet design significantly alter residue dispersion patterns. Forensic ballistics experts must utilize the specific impounded firearm and identical ammunition from the same manufacturer batch to conduct test firings at known distances for valid pattern comparisons with evidence garments.

28. (A) The path of a projectile from the firearm muzzle to the impact point
Bullet trajectory defines the spatial flight path taken by a projectile through air after leaving the firearm muzzle until reaching its final destination or target impact point. External ballistics analyzes factors shaping this trajectory, including velocity, gravity, aerodynamic drag, wind deflection, and barrel stabilization, enabling forensic scientists to geometrically model projectile flight lines during crime scene reconstruction.

29. (B) Ultraviolet (UV) light or Infrared (IR) photography
Dark or blood-stained clothing obscures visual identification of soot, propellant particles, and bullet wipe around entrance holes. Infrared photography penetrates dark dyes and blood staining because underlying fabric reflects infrared light while carbonaceous soot deposits absorb it strongly. This optical contrast reveals previously invisible gunshot residue patterns without chemically altering or destroying delicate physical evidence on garments.

30. (B) 30 degrees
The impact angle of a projectile striking a flat surface is calculated using the trigonometric formula where the sine of the angle equals the minor axis width divided by the major axis length. Dividing ten millimeters by twenty millimeters yields zero point five. The arcsine of zero point five corresponds precisely to a thirty-degree impact angle relative to the surface plane.

31. (A) Rods must be inserted gently to avoid damaging the margins of the bullet hole.
Trajectory rods determine spatial angles by passing through physical defects created by bullets in targets. Inserting rods requires extreme gentleness to preserve delicate hole margins containing physical trace evidence, bullet wipe, and fabric fibers. Forceful insertion distorts original entry dimensions, alters original angular alignments, and risks introducing artificial tool marks that corrupt accurate spatial trajectory reconstruction.

32. (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
Physical strings placed over extended distances experience gravitational sag, creating curved trajectories that misrepresent straight projectile paths. Lasers project straight light beams unaffected by gravity across room-scale or outdoor distances. Consequently, laser trajectory reconstruction avoids physical drooping errors, providing precise linear alignment for measuring vertical elevation and horizontal azimuth angles across extended shooting scene distances.

33. (D) Applying aerosol smoke or working in low-light conditions
Laser light traveling through clear air remains invisible from side angles unless light scatters off suspended airborne particles. Photographers introduce fine aerosol smoke, fog, or dust along the beam path and reduce ambient room lighting. This scattering effect illuminates the continuous laser trajectory line, enabling long-exposure camera capture of the exact flight path for crime scene documentation.

34. (A) 2, 3, 4, 1
When a high-velocity bullet strikes flat glass, the impact stresses the front surface first. The glass bends forward under pressure, causing tension on the opposite exit side. Tensile failure initiates radial fractures originating on the exit surface and radiating outward. Continued forward displacement causes bending stress on front segments, generating secondary concentric fractures on the entry side.

35. (B) A pinch point on entry and an elongated wipe toward exit
An oblique bullet strike against thin sheet metal deforms the entry margin, creating a distinct

NODIA

71. (A) Bullet wipe
Bullet wipe is a dark, greasy ring deposited around the perimeter of an entrance hole when a projectile impacts skin or clothing. As the bullet penetrates fabric or tissue, surface friction scrapes off accumulated barrel lubricants, metallic bullet shaving traces, primer combustion residues, and soot held on the outer surface of the bullet, forming a distinct circumferential border.

72. (D) The 3R rule (Radial cracks form a Right angle on the Reverse side of the force)
The 3R rule guides fracture edge interpretation in forensic glass analysis. By examining microscopic stress lines along radial crack edges, investigators observe that radial fractures form right angles on the reverse side of the applied force. This diagnostic relationship allows ballistics experts to establish definitively whether a bullet impacted the front or rear surface of a broken glass pane.

73. (B) Entry hole is cleanly punched and narrow; exit hole is wider and beveled.
When a high-velocity bullet penetrates flat cranial bones, structural damage reflects directionality. The impact on the outer table cleanly punches a round entry hole with sharp edges. As the bullet continues through internal bone layers, energy displacement pushes material outward, producing extensive internal beveling on the inner table at entry and external cone beveling on the outer table at exit.

74. (C) Microscopic melting of synthetic fibers from friction
High-velocity bullets generate substantial thermal energy through internal air compression and barrel friction during flight. When passing through synthetic textiles composed of thermoplastic polymers like polyester or nylon, the projectile transfers localized heat upon contact. This rapid thermal transfer melts fiber ends along entry hole margins, leaving fused microscopic synthetic beads visible under stereomicroscopic examination.

75. (D) Infrared
Infrared imaging represents the standard technique for examining dark or bloodied garments around bullet entry sites. Synthetic dye molecules and hemoglobin absorb visible light strongly, obscuring carbonaceous soot deposits. However, under near-infrared illumination, dark dyes reflect radiation while carbon soot absorbs it intensely, creating strong optical contrast that clearly reveals previously invisible gunshot residue distribution patterns.

76. (A) Secondary missiles
When a primary bullet strikes rigid anatomical structures such as ribs or long bones, extreme force shatters bone into sharp fragment pieces. Driven forward along the kinetic velocity path of the bullet, these high-velocity bone fragments behave as secondary missiles. They penetrate adjacent soft organs, creating independent laceration tracks separate from the main projectile path during terminal ballistics interaction.

77. (B) Cartesian coordinate system
The Cartesian coordinate system uses three mutually perpendicular spatial axes labeled X, Y, and Z to define precise locations within three-dimensional space. Modern 3D laser scanners and crime scene mapping software employ Cartesian coordinates to record spatial positions of bullet impact defects, trajectory vectors, and room boundaries, facilitating accurate mathematical reconstruction of complex shooting events.

78. (B) ASTM International
ASTM International publishes standard E1588, which serves as the premier internationally recognized protocol governing gunshot residue analysis via electron microscopy. This consensus standard outlines detailed procedures for specimen preparation, automated particle search parameters, energy dispersive X-ray spectral identification criteria, and manual confirmation rules required to achieve scientifically rigorous laboratory results acceptable in judicial proceedings.

NODIA

79. (A) Findings match expected weapon firing, though other sources are possible.
Forensic expert opinions must maintain objective scientific limits. Stating that detected particles are consistent with firearm discharge indicates that chemical composition and particle morphology match known discharge residues. However, because secondary transfer or environmental exposure to identical elemental combinations remains possible, the expert avoids claiming absolute proof of direct weapon firing by a specific individual.

80. (B) Section 39
Under the Bharatiya Sakshya Adhiniyam, 2023, expert testimony regarding scientific, technical, or specialized knowledge is governed under Section 39. This legal provision allows courts to consider opinion evidence provided by qualified forensic ballistics experts concerning gunshot residue findings, distance determinations, and trajectory calculations when reconstructing facts related to criminal shooting investigations.

81. (D) Corroborate witness statements and reconstruct event sequence
Integrating multiple physical evidence streams allows forensic scientists to evaluate crime scene scenarios objectively. Combining gunshot residue distance estimates, trajectory spatial angles, and medical autopsy wound tracks provides a rigorous scientific framework. This integrated analysis verifies or refutes witness statements, establishes spatial positioning of participants, and determines the chronological sequence of events during shooting incidents.

82. (C) Automotive brake pads
Automotive brake pad linings utilize heavy metal compounds including barium sulfate and antimony sulfide for friction control and heat dissipation. Mechanical friction during braking sheds fine particles containing barium and antimony into environmental air. Without evaluating particle morphology through electron microscopy, elemental screening of mechanics' hands can produce false positives due to these occupational non-firearm sources.

83. (B) Sulfanilic acid and alpha-naphthylamine
The Walker test utilizes sulfanilic acid and alpha-naphthylamine reagents bound within an acidic matrix to detect nitrite residues. When nitrites present on target garments react with sulfanilic acid, a diazonium salt forms. This intermediate couples immediately with alpha-naphthylamine, producing a bright orange-red azo dye pattern that maps the spatial distribution of partially burnt powder particles around entry defects.

84. (D) Hand washing, wiping hands, and normal friction
Microscopic gunshot residue particles adhere loosely to skin through weak mechanical surface contact. Active physical behavior involving hands—such as thorough washing with soap and water, wiping hands on clothing, rubbing palms against surfaces, or vigorous physical movement—rapidly dislodges these particles. Most residue is shed within hours, making friction and washing the primary loss mechanisms.

85. (A) Significantly washed away or distorted
Heavy rainfall introduces strong mechanical flushing forces and water saturation to outdoor crime scenes. Soluble chemical components of gunshot residue like nitrites dissolve rapidly in water, while loosely bound metallic particulate deposits wash off target garments. Consequently, exposure to torrential rain significantly diminishes recoverable residue density and severely distorts original spatial distribution patterns around impact defects.

86. (C) Wrap suspect's hands in paper bags secured at wrists
To preserve fragile gunshot residue on a suspect's hands during transport, investigators wrap both hands in clean, breathable paper bags tied securely at the wrists. Paper bags prevent mechanical wiping loss against clothing while avoiding moisture condensation. Plastic bags trap sweat, causing skin dampness that mobilizes particles and leads to sample loss or degradation before formal laboratory collection.

87. (A) It provides a rigid surface to crush the primer mixture upon impact.
In centerfire cartridge primers, the anvil is a rigid internal metal piece fixed inside the primer cup directly above the explosive chemical mix. When a firing pin strikes the external center of the cup, it crushes the explosive mixture against the sharp rigid anvil. This sudden mechanical compression generates heat and friction, initiating primary detonation.

88. (D) Exit side of the bullet
When a projectile penetrates a fibrous, rigid medium like wood, structural stress distribution varies along the path. The bullet cleanly punches an entry hole on the front surface under compression. As it emerges on the far side, tensile stress pushes wood fibers outward beyond their elastic limit, creating extensive rough splintering around the exit defect.

89. (B) Strikes the target while yawing or tumbling sideways
A keyhole defect occurs when a bullet destabilizes in flight and strikes a target surface while

Downloaded from www.pdf.tube

tumbling or pitched sideways at a extreme yaw angle. Rather than presenting its narrow pointed nose, the elongated side profile of the bullet impacts the material, leaving an asymmetrical, elongated keyhole-shaped penetration defect that reflects the destabilized orientation of the projectile.

90. (C) Shooting deposits GSR onto surroundings while transferring residues to the shooter.
Locard's Exchange Principle asserts that physical contact produces mutual trace evidence exchange. In ballistics, discharging a firearm generates a expanding plume of vaporized and particulate materials. This chemical cloud deposits residue onto surrounding environmental surfaces, targets, and clothing, while simultaneously transferring microscopic metallic particles onto the hands, skin, and apparel of the person firing the weapon.

www.nodia.in

NODIA

CHAPTER 30
Tool Marks Examination

1. In forensic science, how is a tool mark formally defined?
(A) Any trace biological evidence left behind by an instrument used in a crime
(B) Any impression, cut, gouge, or abrasion caused by a tool coming into contact with another object
(C) Only the striated patterns transferred from a metal object to a softer surface
(D) The chemical residue left on a surface after an explosive device has been manipulated

2. Which fundamental principle of forensic science is most directly demonstrated when a pry bar leaves a distinct structural imprint on a wooden door frame?
(A) Archimedes' Principle
(B) Principle of Individuality
(C) Principle of Sequential Unmasking
(D) Locard's Exchange Principle

3. What constitutes a class characteristic of a tool?
(A) Features established during the manufacturing process that are common to a group of similar tools
(B) Random microscopic irregularities on the tool's working edge
(C) Wear and tear accumulated by the tool over years of specific usage
(D) Nicks and gouges caused by the tool striking a harder metal object

4. In the examination of a screwdriver recovered from a burglary, the forensic examiner notes a unique chip on the blade edge. What type of characteristic is this?
(A) Subclass characteristic
(B) Class characteristic
(C) Individual characteristic
(D) Form characteristic

5. Subclass characteristics in tool marks are defined as features that are:
(A) Incidental features common to a batch of tools rather than an entire class
(B) Unique features produced by unpredictable physical wear and surface abrasion
(C) Intentional design traits added to specify tool size and model variations
(D) Dynamic surface patterns depending entirely on the angle of tool impact

6. When a hammer strikes a wooden surface directly without sliding, what type of tool mark is primarily produced?
(A) Linear striated or sliding scrape mark
(B) Continuous extrusion or drawn metal mark
(C) Superficial friction or surface drag mark
(D) Direct compression or impressed mark

7. Striated or sliding tool marks are most typically left by which of the following actions?
(A) A bolt cutter rapidly snapping through a hardened steel padlock shackle
(B) A flathead screwdriver pushed parallel across a metal safe surface
(C) A heavy hammer striking directly against a hardened steel nail head
(D) A sharp punch tool creating a deep indentation in a steel plate

8. Match the tool type in List I with the typical mark it produces in List II.
List I: (Tool Type)
P. Pry bar
Q. Hacksaw
R. Wire cutter
S. Hammer
List II: (Mark Produced)
1. Kerf marks
2. Compression marks
3. Leverage/Combination marks
4. Pinch/Shear marks
(A) P-1, Q-2, R-3, S-4
(B) P-4, Q-3, R-2, S-1
(C) P-3, Q-1, R-4, S-2
(D) P-3, Q-4, R-1, S-2

9. In forensic examination, when two opposing jaws of a tool close completely to separate an object, causing the metal to yield and break, what type of mark is primarily left on the cut ends?

Click Here to Buy book on Amazon

(A) Slicing mark
(B) Gouge mark
(C) Impressed leverage mark
(D) Pinch and shear mark

10. A combination tool mark is best described as:
(A) A single mark exhibiting both impressed and striated characteristics
(B) A mark made by two different tools simultaneously
(C) A mark showing overlapping impressions from multiple strikes of the same tool
(D) A mark containing both physical and biological evidence

11. Marks left by pliers and wrenches usually occur because these tools are designed to:
(A) Slice cleanly through rigid materials in a linear motion
(B) Grip objects tightly, leaving opposing jaw impressions
(C) Strike target surfaces directly with high impact velocity
(D) Melt metallic substrates through intense friction heating

12. Consider the following statements regarding marks made by saws:
I. Saws create a distinct cut channel known as a kerf.
II. The kerf can help determine the thickness of the saw blade.
III. Striations left by saw teeth cannot be used for any forensic comparison.
Which of the above statement(s) is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

13. Which of the following is the most appropriate technique for examining drill hole marks left on an iron safe?
(A) Silicone casting of the interior hole to replicate striations
(B) Application of chemical etching reagents inside the drill hole
(C) Dusting surrounding exterior surfaces with magnetic powder
(D) Extracting fine residual metal shavings for DNA profiling

NODIA

14. Which among the following tools is most likely to leave a slicing or cutting mark exhibiting parallel microscopic striations?
(A) A heavy sledgehammer striking a concrete wall
(B) A high-leverage crowbar applied to a wooden frame
(C) A knife blade drawn cleanly across a surface
(D) A solid blunt punch tool driven by a mallet

15. In a typical rural burglary involving the forcing of a heavy padlock, the examination of the lock shackle reveals deep, V-shaped indented cuts on opposite sides. This indicates the use of:
(A) A hacksaw
(B) An electric drill
(C) A screwdriver
(D) A bolt cutter

16. What is the primary purpose of examining a lock cylinder for lock picking marks?
(A) To identify the specific original manufacturer and model of the lock cylinder
(B) To reconstruct the exact mechanical bitting sequence of the original key code
(C) To detect microscopic scratches on internal pins left by picking tools
(D) To reveal volatile trace chemical residues left by explosive breach devices

17. When investigating a safe peeling operation, what type of tool mark is a forensic examiner most likely to encounter?
(A) Deep cylindrical drill hole patterns concentrated around the dial assembly
(B) Impressed and striated pry bar leverage marks on the metal skin
(C) Continuous parallel kerf mark channels produced by a high-speed saw
(D) Extensive thermal melting slag resulting from an oxyacetylene torch cut

18. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Suspect tools must never be physically fitted into the crime scene tool marks.
Reason (R): Fitting the tool into the mark can alter the evidentiary mark and transfer trace evidence, thereby destroying forensic integrity.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.

but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

55. Match the tyre mark term in List I with its description in List II.
List I: (Term)
P. Sipes
Q. Grooves
R. Ribs
S. Pitch
List II: (Description)
1. Small slits molded into tread blocks to increase traction
2. Circumferential channels separating tread ribs
3. The row of tread blocks around the circumference
4. The varied sizes of tread blocks to reduce noise
(A) P-2, Q-1, R-4, S-3
(B) P-1, Q-2, R-3, S-4
(C) P-1, Q-3, R-2, S-4
(D) P-3, Q-2, R-1, S-4

56. Which branch of forensic science primarily deals with the analysis of bite marks found on human skin or food items?
(A) Forensic Pathology
(B) Forensic Toxicology
(C) Forensic Odontology
(D) Forensic Entomology

57. While examining a fresh bite mark on a victim, an investigator must swab the area before washing it. What is the primary forensic purpose of this swab?
(A) To measure local physiological surface pH variations across the injury site
(B) To thoroughly clean epidermal debris to enhance photographic contrast
(C) To isolate and quantify residual toxic poisons present on skin surfaces
(D) To collect saliva and skin cells for biter DNA profiling

58. Consider the following statements regarding bite marks:
I. Human bite marks on skin generally produce a U-shaped or semi-circular pattern.
II. A bite mark must always be photographed using an ABFO No. 2 scale.
III. Time-dependent skin distortion does not affect the measurement of a bite mark on a living victim.
Which of the above statement(s) is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

59. The standard scale designed specifically by the American Board of Forensic Odontology for the accurate photographic documentation of bite marks is the:
(A) Metric straight edge
(B) ABFO No. 2 scale
(C) Pantone color scale
(D) Vernier caliper scale

60. "Physical fit" or "fracture matching" is the process of:
(A) Comparing nuclear DNA profiles obtained from suspect samples against crime scene bloodstains
(B) Reassembling broken or torn pieces to prove original continuity
(C) Analyzing microscopic striation line patterns along the land impressions of fired bullets
(D) Evaluating physical shoe outer dimensions to establish general agreement with scene prints

61. Which type of evidence is considered the highest level of individualization in physical trace evidence?
(A) A physical fit between two torn paper pieces
(B) Spectrophotometric color matching of two distinct paint chips
(C) Accurate refractive index matching of recovered glass fragments
(D) Establishing identical manufacturer class traits on a tyre tread

62. Consider the following types of evidence that might undergo physical fit examination:
I. A broken piece of a car headlamp found at a hit-and-run scene
II. Torn masking tape used to bind a victim
III. A sheared metal bolt at a factory sabotage scene
IV. Splinters of a wooden baseball bat
Which of the above can potentially be individualized through fracture matching?
(A) I and II only
(B) I, II, and III only
(C) II and IV only
(D) I, II, III, and IV

Downloaded from www.pdf.tube

28. In the evaluation of striated tool marks, CMS stands for:
(A) Central Microscopic Striations
(B) Consecutive Matching Striae
(C) Calculated Matching Striae
(D) Correlated Mark Similarity

29. According to the Biasotti criteria for Consecutive Matching Striae (CMS) in 3D tool marks, an identification is justified when there is an agreement of:
(A) Two groups of at least 3 consecutive matching striae, or one group of 6
(B) Any single continuous group comprising at least 3 consecutive matching striae
(C) Any single continuous group comprising at least 10 consecutive matching striae
(D) A minimum of 5 non-consecutive matching striae distributed across the mark surface

30. Which fundamental physical property allows an erased or obliterated serial number stamped on metal to be chemically restored?
(A) Stamping permanently lowers the local metal melting point directly at the strike location
(B) Stamping ink diffuses deeply into the sub-surface atomic crystal lattice of the metal alloy
(C) Stamping causes plastic deformation, altering sub-surface reactivity
(D) Stamping accelerates atmospheric oxidation rates across polished metallic surfaces

31. Match the etching reagent in List I with the target material it is primarily used to restore serial numbers on in List II.
List I: (Etching Reagent)
P. Fry's Reagent
Q. Villela's Reagent
R. Sodium Hydroxide solution
S. Nitric acid (dilute)
List II: (Target Material)
1. Aluminium alloys
2. Copper and Brass
3. Steel and Iron
4. Lead and Zinc
(A) P-3, Q-4, R-1, S-2
(B) P-1, Q-3, R-2, S-4
(C) P-2, Q-1, R-3, S-4
(D) P-3, Q-1, R-1, S-2

32. In the restoration of serial numbers, what is the purpose of smoothing the obliterated area with abrasive paper prior to applying chemical reagents?
(A) To induce localized frictional heating and facilitate thermal expansion of digits
(B) To expand existing surface scratches so acid distribution remains completely uniform
(C) To create a smooth surface for observing differential chemical etching
(D) To embed abrasive silicon carbide particles directly into the underlying metal matrix

33. Fry's Reagent, commonly used in forensic laboratories for restoring serial numbers on iron and steel firearms, primarily consists of:
(A) Nitric acid, Sulfuric acid, and Water
(B) Cupric chloride, Hydrochloric acid, and Water
(C) Sodium hydroxide, Potassium hydroxide, and Water
(D) Ferric chloride, Acetic acid, and Water

NODIA

34. Which serial number restoration method utilizes an external power source connected to the metal object (anode) and a swab moistened with an electrolyte (cathode)?
(A) Standard magnetic particle examination method
(B) Direct chemical acid etching restoration method
(C) Non-contact thermal heating restoration method
(D) Electrolytic (electro-chemical) method

35. Consider the following statements about restoring serial numbers on polymers/plastics (e.g., modern car batteries or synthetic firearm frames):
I. Chemical etching with strong acids is the primary method used.
II. The application of localized heat or specialized chemical solvents can sometimes reveal obliterated markings on plastics.
III. Serial numbers molded into plastics leave no underlying zone of strain.
Which of the above statement(s) is/are correct?
(A) I and II only
(B) II only
(C) I and III only
(D) II and III only

36. The magnetic particle method for serial number restoration is effective ONLY on:
(A) Aluminium engine blocks
(B) Copper electrical wiring

(C) Ferromagnetic metals like iron and steel
(D) High-density polyethylene (HDPE) plastics

37. During chemical etching, why does the obliterated number reappear?
(A) The reagent preferentially dissolves the underlying strained metal lattice
(B) The reagent selectively deposits a dark metallic dye into pre-existing stamping grooves
(C) The reagent forces compressed sub-surface metal layers to expand outward rapidly
(D) The reagent reacts exclusively with atmospheric oxygen gas entrapped within the metal alloy

38. A stolen vehicle recovered has its chassis number completely ground off. Which non-destructive method can be attempted first for restoring the chassis number before using corrosive acids?
(A) Fry's Reagent etching
(B) Electrolytic etching
(C) Oxy-acetylene torch heating
(D) Magnetic particle testing

39. What is the most critical step once an obliterated serial number becomes visible during the chemical etching process?
(A) Re-apply concentrated acid solution immediately across the metal surface to fix the restored digits
(B) Photograph and document the number immediately before it fades
(C) Polish the restored surface vigorously with abrasive paper to enhance visual digit contrast
(D) Mechanically strike the area using a hammer to permanently seal internal metal strain zones

40. In footprint/footwear examination, which feature represents an individual characteristic?
(A) A standardized herringbone tread design pattern
(B) A commercially designated shoe size (e.g., Size 9)
(C) A distinct cut from stepping on broken glass
(D) A manufacturer's logo molded into the shoe heel

41. A 2D footwear impression left in dry dust on a smooth tile floor is best recovered using:
(A) High-strength dental stone casting mix
(B) Standard liquid plaster of Paris mixture
(C) Flexible silicone rubber casting compound
(D) Electrostatic Dust Print Lifter (ESDL)

42. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Dental stone is preferred over Plaster of Paris for casting 3D footwear impressions in soil.
Reason (R): Dental stone has a higher compressive strength, lower setting expansion, and captures finer details than Plaster of Paris.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

43. When attempting to cast a footwear impression in loose, dry sand, the investigator should first carefully apply:
(A) A gentle stream of liquid water to compact loose substrate particles
(B) A light spray of aerosol fixative to stabilize loose soil
(C) A protective heavy coating of liquid petroleum jelly across the mark
(D) Localized radiant thermal heat emitted from a portable butane torch

44. What specialized product is used to highlight and insulate a 3D footwear impression in snow prior to casting with cooled dental stone?
(A) Mikrosil
(B) Snow Print Wax
(C) Ninhydrin spray
(D) Cyanoacrylate fuming

45. Arrange the following steps for comparing a suspect's shoe to a scene impression in the correct order:
1. Examine known shoe for class characteristics.
2. Compare scene impression to known shoe test marks.
3. Obtain known test impressions of the suspect's shoe.
4. Evaluate scene impression for class and individual characteristics.

(A) 4, 1, 3, 2
(B) 1, 3, 4, 2
(C) 4, 3, 1, 2
(D) 3, 1, 4, 2

Click Here to Buy book on Flipkart

46. In the forensic analysis of footwear, "pronation" and "supination" refer to:
(A) The high-temperature industrial chemical process used in vulcanizing outer synthetic rubber soles
(B) The specialized chemical enhancement procedure applied when developing faint latent footwear dust prints
(C) Sole wear patterns caused by walking gait (inward/outward roll)
(D) The standardized physical dimensions and proportional measurements comprising nominal shoe size

47. To obtain a high-quality standard known impression of a suspect's shoe that captures the 3D depth and profile, a forensic examiner might step the shoe into:
(A) A shallow tray of freshly mixed wet concrete
(B) A specialized container filled with liquid silicone
(C) A heated metal tray containing melted paraffin wax
(D) Bio-foam (a compressible foam block)

48. What does the "track width" (or stance) of a vehicle refer to in tyre mark examination?
(A) The linear longitudinal clearance measured between the primary front axle and the rear axle assembly
(B) The complete outer rotational distance along the tread face representing total tyre circumference
(C) Center-to-center distance between right and left tyres on an axle
(D) The vertical measurement taken from the top of the tread block down to the base groove channel

49. The distance from the center of the front hub to the center of the rear hub of a vehicle is called the:
(A) Track width
(B) Wheelbase
(C) Turning radius
(D) Tread depth

50. Consider the following features of a tyre:
I. Tread design
II. Manufacturer's brand name
III. Random cuts from road debris
IV. Sipes and slots
Which of the above are considered class characteristics?
(A) I, II, and IV only
(B) II, III, and IV only
(C) I and IV only
(D) I, II, III, and IV

51. In vehicle accident reconstruction, what are "yaw marks"?
(A) Curved striated marks from a rotating, sliding tyre
(B) Straight drag marks produced when fully locked wheels slide forward across pavement
(C) Static three-dimensional tread impressions deposited by a stationary wheel in soft mud
(D) Unburned chemical residue deposits deposited along the roadway from exhaust systems

52. Tread Wear Indicators (TWIs) or "wear bars" are:
(A) Specialized electronic pressure sensors integrated into modern inner tyre tubeless rims
(B) Calibrated mechanical depth gauges utilized by forensic collision reconstruction experts
(C) Raised rubber bars in tread grooves flush at specific wear levels
(D) Highly reflective safety indicator strips vulcanized directly onto the outer tyre sidewall

53. If an investigator at a hit-and-run scene recovers a 2-meter long tyre track segment in mud, what is the best practice for casting?
(A) Cast overlapping 1 to 1.5 foot segments to prevent cast breakage
(B) Cast the entire 2-meter continuous track as a single massive dental stone block
(C) Cast a single localized 3-inch section exhibiting the clearest tread detail
(D) Document exclusively via photography since extended track casts lack structural integrity

54. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Skid marks can be used to estimate the minimum speed of a vehicle prior to braking.
Reason (R): Skid marks are formed by the heat generated from the friction of locked tyres sliding over the road surface.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true

Downloaded from www.pdf.tube

(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

19. Prior to lifting or casting any tool mark at a crime scene, the first mandatory step of documentation is:
(A) Documenting through scaled photography with oblique light
(B) Applying a suitable release agent to prepare for tool casting
(C) Swabbing the impression area thoroughly to collect trace metals
(D) Measuring the outer boundaries precisely with a metal caliper

20. Why is oblique lighting specifically recommended for photographing tool marks?
(A) It completely eliminates surface shadows to produce a uniformly bright image
(B) It isolates the examination area from thermal surface damage caused by flash heat
(C) It creates contrasting shadows in fine impressions to reveal 3D detail
(D) It selectively fluoresces latent biological fluid residues within the impression

21. Which material is most commonly used by forensic laboratories for casting fine microscopic striations in tool marks?
(A) Silicone rubber medium (e.g., Mikrosil)
(B) High-grade calcined plaster of Paris
(C) High-strength dental stone plaster
(D) Standard non-hardening modeling clay

22. Select the correct order of steps for processing a tool mark on a fixed window frame at a crime scene.
(A) Apply casting medium → Photograph with scale → Remove casting → Package cast securely
(B) Photograph scene → Apply release agent → Apply casting medium → Photograph cast in place
(C) Photograph with scale under oblique light → Apply cast → Remove set cast → Package
(D) Package substrate window frame → Photograph substrate → Cast mark in lab → Compare

23. While processing a burglary scene, the investigating officer decides to use dental stone instead of silicone rubber. For which type of impression is dental stone generally preferred?
(A) Microscopic striations on a cut padlock shackle
(B) Deep, 3D footwear impressions in muddy soil
(C) Fine leverage marks on an aluminum door frame
(D) Shallow scratches on a painted car door

24. When packing a suspect pry bar for submission to the forensic science laboratory, the working edge of the tool should be:
(A) Left fully exposed to facilitate immediate laboratory examination
(B) Coated with protective oil to prevent atmospheric oxidation rusting
(C) Wrapped in heavy paper to prevent damage and preserve evidence
(D) Thoroughly scrubbed using a wire brush to remove surface debris

NODIA

25. Consider the following statements about creating test marks in a forensic laboratory:
I. Test marks are made using the suspect tool on a material softer than or similar to the evidence material.
II. Lead and modelling clay are frequently used for making test marks.
III. The angle and pressure applied while making a test mark do not affect the resulting striation pattern.
IV. Multiple test marks at varying angles are often required to find a match.
Which of the above statement(s) is/are correct?
(A) I, II, and IV
(B) II, III, and IV
(C) I, III, and IV
(D) I, II, and III

26. Which instrument is standard for the simultaneous side-by-side microscopic examination of a crime scene tool mark cast and a laboratory test mark?
(A) Comparison Microscope
(B) Scanning Electron Microscope (SEM)
(C) Phase Contrast Microscope
(D) Stereomicroscope

27. An optical bridge is a critical component of which forensic instrument used in tool mark identification?
(A) Gas Chromatograph
(B) Comparison Microscope
(C) Fourier Transform Infrared Spectrometer
(D) Compound Light Microscope

63. When examining glass fracture surfaces for a physical fit, the forensic expert often looks for distinct ridge-like marks on the radial fracture edges. These are called:
(A) Linear structural extrusion lines
(B) Microscopic striae of compression
(C) Transverse saw kerf marks
(D) Wallner lines (Rib marks)

64. Extrusion marks, which are parallel striations formed during the manufacturing process, are most useful for the forensic comparison of:
(A) Cast iron safe doors
(B) Footwear rubber soles
(C) Plastic garbage bags
(D) Toughened glass panes

65. When a tool mark examiner concludes that a suspect tool "produced" the crime scene mark, this means:
(A) Class characteristics match fully, though positive individualization remains scientifically impossible.
(B) Another tool producing the mark is a practical impossibility.
(C) The tool was likely present at the crime scene, though an alternate tool created the evidence mark.
(D) Observed physical features are strictly limited to batch-manufactured subclass characteristics.

66. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Over time, the heavy use of a tool may prevent a forensic examiner from positively matching it to an older tool mark.
Reason (R): Extensive use alters the microscopic individual characteristics on the working edge of the tool.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

67. The Association of Firearm and Tool Mark Examiners (AFTE) standard recognizes which of the following as a formal conclusion category?
(A) Inconclusive
(B) Absolute Mathematical Certainty
(C) Highly Probable with 95% confidence
(D) Visually Similar

68. What is the primary limitation of matching an extensively rusted pry bar recovered a year after a burglary to a tool mark cast made at the scene?
(A) Silicone casting materials degrade structurally when stored over extended twelve-month periods
(B) Environmental rust significantly alters primary class characteristics like pry bar blade size and shape
(C) Oxidation destroys fine microscopic individual striations
(D) Heavily oxidized metallic surfaces present biological safety risks during comparison microscopy

69. Select the correct sequence of action for a first responder securing a burglary scene where a tool mark is visible on the door:
(A) Secure scene → Protect mark → Inform FSL → Expert photograph/cast
(B) Apply casting material → Photograph scene → Inform FSL → Secure the outer crime scene perimeter
(C) Remove affected door panel → Transport to police station → Request expert forensic examination
(D) Search for suspect tool → Test fit tool into crime scene mark → Secure surrounding area

70. When analyzing tyre marks, what information can determine the direction of travel?
(A) Transverse measurements defining full track width dimensions
(B) Commercial manufacturer brand name molded along the sidewall
(C) Standardized diameter measurements of the metal wheel rim
(D) Soil displacement, flattened grass, and fluid drops

71. In forensic laboratory practice, chemical restoration of an engine number on a stolen tractor involves first applying a degreasing agent. Why is this necessary?
(A) To prevent bare metallic surfaces from undergoing rapid atmospheric oxidation rusting
(B) To clean grease so etching acid reacts evenly with metal
(C) To significantly enhance local magnetic field permeability across cast iron substrates

Click Here to Buy book on Amazon

characteristics without damaging or permanently altering the footwear.

48. (C) Center-to-center distance between right and left tyres on an axle
Track width, also known as stance, is the linear distance measured between the centerlines of opposing left and right tyres mounted on the same axle. In forensic collision reconstruction and vehicle identification, track width helps narrow down potential vehicle makes and models by comparing scene tire impressions against manufacturer vehicle specification databases.

49. (B) Wheelbase
Wheelbase is defined as the longitudinal distance measured from the center of the front axle wheel hub to the center of the rear axle wheel hub. Along with track width, wheelbase serves as a key dimensional measurement in vehicle identification and accident reconstruction, allowing forensic experts to establish the structural class and model of an unknown vehicle.

50. (A) I, II, and IV only
Tread design, brand manufacturer names, and molded sipes or slots represent standard design specifications established during mass industrial manufacturing. Because these features are common to all identical tyres within a production line, they are classified as class characteristics. In contrast, random cuts or punctures caused by road debris represent unique individual characteristics.

51. (A) Curved striated marks from a rotating, sliding tyre
Yaw marks are curved, striated tyre marks produced when a vehicle travels in a curved path while sliding sideways. They occur when cornering forces exceed tyre traction, causing the rotating wheel to slip laterally. The resulting marks feature distinct diagonal striations, providing critical physical data for estimating vehicle speed and dynamics during collision reconstruction.

52. (C) Raised rubber bars in tread grooves flush at specific wear levels
Tread Wear Indicators, commonly called wear bars, are elevated rubber strips molded transversely across the deep main grooves of a tyre tread. As the tread wears down to a legal minimum depth—typically 1.6 millimeters—the wear bars become flush with the surrounding tread blocks, providing visual evidence of tyre wear during forensic examinations.

53. (A) Cast overlapping 1 to 1.5 foot segments to prevent cast breakage
When encountering an extended continuous tyre track, casting a single long section creates a fragile, unwieldy slab prone to cracking or structural failure. Best forensic practice involves pouring dental stone in manageable, overlapping segments between 1 and 1.5 feet long. This ensures structural integrity while preserving complete, continuous tread detail across the full track length.

54. (B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
Skid mark length enables forensic collision investigators to calculate the minimum speed of a vehicle prior to braking through work-energy equations. Frictional heat generated as locked sliding tyres skid across pavement melts tread rubber and road bitumen, forming visible skid marks. Frictional heating explains mark formation mechanics, whereas speed estimation relies on physics principles.

55. (B) P-1, Q-2, R-3, S-4
Sipes are small slits cut into tread blocks to increase traction on wet surfaces. Grooves are deep circumferential channels separating tread ribs. Ribs form continuous rows of tread blocks around the tyre circumference. Pitch variation refers to varying tread block sizes designed by manufacturers to minimize acoustic tire noise during road travel.

56. (C) Forensic Odontology
Forensic Odontology is the branch of forensic science that applies dental principles to legal investigations. It encompasses human identification through dental records and the scientific evaluation of bite marks found on skin or inanimate substrates. Odontologists analyze dentition patterns, arch alignment, and individual tooth features to compare suspect teeth with bite mark impressions.

57. (D) To collect saliva and skin cells for biter DNA profiling
Swabbing a bite mark before washing or chemical treatment is essential to collect biological trace evidence. When a perpetrator bites a victim,

NODIA

80. Identify the incorrect statement regarding the comparison microscope used in tool mark identification.
(A) It consists of two objective lenses and a single field of view split in the middle.
(B) It allows the examiner to alter the lighting independently on both the evidence and test marks.
(C) It automatically calculates the statistical probability of a tool mark match.
(D) The magnification of both optical paths must be identical for accurate comparison.

81. Consider the following outcomes of a tool mark comparison:
I. Identification (Positive match)
II. Exclusion (Negative match)
III. Inconclusive
Which of the above are recognized outcomes under the AFTE standard?
(A) I and II only
(B) I and III only
(C) II and III only
(D) I, II, and III

82. Which statement best describes a limitation of using dental stone for footwear casting at a crime scene?
(A) Its coarse grain structure fails to capture fine microscopic detail when compared against Plaster of Paris
(B) It requires multiple weeks of room-temperature curing before cast recovery can be safely attempted
(C) It completely dissolves upon exposure to ambient groundwater or rainwater shortly after setting
(D) Exothermic heat during setting can melt snow impressions

83. An investigator finds a piece of broken taillight glass at the scene of a fatal accident. A suspect vehicle is found with a broken taillight. Which examination will provide the strongest evidence that the suspect vehicle was at the scene?
(A) A fracture fit between scene and vehicle glass
(B) Precise laboratory refractive index matching of both recovered glass samples
(C) Detailed elemental chemical analysis comparing the exact polymer plastic composition
(D) Objective spectral color comparison using a precision benchtop spectrophotometer

84. The "Daubert standard" in forensic law primarily impacts tool mark examination by emphasizing the need for:
(A) Mandatory establishment of a minimum threshold of 20 identical physical comparison points
(B) Exclusive reliance on fully automated, computer-driven pattern recognition matching algorithms
(C) Known error rates, empirical testing, and peer review
(D) Restricting expert court testimony exclusively to active forensic scientists holding doctoral degrees

85. Arrange the following steps for chemically restoring an obliterated serial number on a steel firearm in the correct sequential order:
1. Application of Fry's Reagent
2. Photography of the obliterated area
3. Polishing the surface to a mirror finish with abrasive paper
4. Cleaning and degreasing the surface
(A) 2, 4, 3, 1
(B) 4, 2, 3, 1
(C) 2, 3, 4, 1
(D) 3, 4, 1, 2

86. Which of the following is considered an environmental factor that can adversely affect the quality of a tool mark left at a crime scene?
(A) The specific Rockwell hardness level of the suspect tool blade
(B) Primary industrial manufacturing methods utilized during tool production
(C) The degree of downward physical pressure applied by the perpetrator
(D) Oxidation, rust, or heavy rain prior to discovery

87. If a forensic examiner encounters a padlock that has been cleanly cut leaving a flat, shiny surface with microscopic parallel lines, the most probable tool used was a:
(A) Heavy-duty mechanical bolt cutter
(B) Hacksaw or abrasive cutting wheel
(C) High-leverage steel crowbar
(D) Heavy hand-held sledgehammer

88. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): It is difficult to individualize a tool mark left on a very hard metal surface by a

Downloaded from www.pdf.tube

29. (A) Two groups of at least 3 consecutive matching striae, or one group of 6
Under the Biasotti criteria for Consecutive Matching Striae in three-dimensional tool marks, a positive forensic identification requires observing either a single continuous group of at least six matching striae or two separate groups each containing at least three consecutive matching striae. This mathematical standard ensures objective, reproducible individualization of tool mark evidence.

30. (C) Stamping causes plastic deformation, altering sub-surface reactivity
Stamping serial numbers into metal induces plastic deformation, permanently altering the sub-surface crystalline grain structure beneath the digits. This localized mechanical stress disrupts the metal lattice, increasing chemical reactivity and strain energy. When etching chemicals are applied to an obliterated surface, the underlying strained region dissolves faster than surrounding unstrained metal, exposing the number.

31. (D) P-3, Q-1, R-1, S-2
Fry's Reagent is primarily formulated for restoring serial numbers on iron and steel objects. Villela's Reagent and Sodium Hydroxide solutions are effectively applied to aluminum alloys to reveal strain patterns. Dilute Nitric Acid serves as a standard etching agent for restoring obliterated markings on copper and brass metallic surfaces during forensic examinations.

32. (C) To create a smooth surface for observing differential chemical etching
Before applying chemical etching reagents, the obliterated metal area must be polished smooth using fine abrasive paper. Smoothing removes superficial grind marks and scratches that could distort reagent contact or obscure faint digits. A polished, mirror-like finish optimizes the visual contrast created by differential etching rates between the strained sub-surface metal and surrounding metal.

33. (B) Cupric chloride, Hydrochloric acid, and Water
Fry's Reagent is an acid etching solution widely utilized in forensic serial number restoration on steel and iron surfaces. It consists of crystalline cupric chloride, concentrated hydrochloric acid, and distilled water. The acidic cupric chloride solution preferentially attacks cold-worked, strained crystalline metal zones beneath stamped numbers, creating sharp visual contrast for digit recovery.

34. (D) Electrolytic (electro-chemical) method
The electrolytic method combines chemical etching with electric current to accelerate differential metal oxidation. The damaged metal specimen functions as the anode, connected to a direct current power supply, while an electrolyte-soaked swab acts as the cathode. Controlled current flow drives rapid, localized dissolution of the strained sub-surface metal, revealing obliterated serial numbers efficiently.

35. (B) II only
Restoring obliterated serial numbers on plastic polymers relies on localized heating or specialized chemical solvents that induce memory effects within distorted polymer chains. Strong chemical acids non-selectively dissolve plastic matrices, while molded or stamped numbers create underlying zones of mechanical strain. Consequently, applying heat or specific solvents represents the viable analytical approach for recovering faint markings.

36. (C) Ferromagnetic metals like iron and steel
Magnetic particle inspection is a non-destructive testing method that relies on magnetic flux leakage around internal physical flaws and strain zones. Consequently, it works exclusively on ferromagnetic materials, such as iron, steel, and nickel alloys. Non-magnetic substrates, including aluminum, brass, copper, and synthetic polymers, cannot be restored using magnetic particle examination techniques.

37. (A) The reagent preferentially dissolves the underlying strained metal lattice
Stamping serial numbers mechanically distorts the atomic crystal lattice beneath the stamped digits, raising internal strain energy. Chemical etching reagents react preferentially with these high-energy, distorted zones, dissolving the strained metal faster than the undisturbed surrounding matrix. This differential rate of dissolution creates a visible relief pattern corresponding to the original obliterated serial numbers.

NODIA

ANSWERS

1. (B) Any impression, cut, gouge, or abrasion caused by a tool coming into contact with another object
A tool mark is defined as any impression, cut, gouge, or abrasion produced when a tool comes into contact with another object. Forensic analysis relies on these physical transfers to establish links between suspect instruments and crime scenes. The structural nature of the resulting mark depends on surface hardness, applied force, and the angle of impact.

2. (D) Locard's Exchange Principle
Locard's Exchange Principle asserts that whenever two objects come into contact, a cross-transfer of physical material occurs. When a pry bar contacts a wooden door frame, it leaves a distinct physical mark while potentially picking up paint or wood traces. This fundamental principle underpins forensic trace evidence identification and scene reconstruction during criminal investigations.

3. (A) Features established during the manufacturing process that are common to a group of similar tools
Class characteristics of a tool encompass design specifications and dimensions established during mass manufacturing processes. These features are inherently shared by all identical tools within the same production line or model series. Forensic examination uses class characteristics to narrow down potential candidate tools by excluding non-matching brands, sizes, shapes, and structural design categories during investigations.

4. (C) Individual characteristic
An individual characteristic represents a unique microscopic feature resulting from random wear, manufacturing imperfections, or post-production damage like chips and nicks. Unlike class characteristics shared by mass-produced tools, individual traits are specific to a single item. Forensic experts rely on these distinct micro-features to positively individualize tool marks to one specific instrument.

5. (A) Incidental features common to a batch of tools rather than an entire class
Subclass characteristics are incidental features imparted to a small group or batch of tools during manufacturing processes, such as machining or grinding wheel wear. These features are broader than individual traits unique to a single tool, yet narrower than overall class characteristics. Forensic examiners must carefully distinguish subclass traits to avoid false positive matches.

6. (D) Direct compression or impressed mark
An impressed or compression tool mark is created when a hard tool exerts direct downward pressure onto a softer surface without sliding movement. Striking a wooden object directly with a hammer leaves a three-dimensional impression reflecting the shape and surface contour of the hammer face. These marks preserve exact structural contours without introducing parallel striations.

7. (B) A flathead screwdriver pushed parallel across a metal safe surface
Striated or sliding tool marks are produced when a tool slides across a surface under lateral pressure, leaving parallel scratches along the movement vector. Pushing a flathead screwdriver parallel against a metal surface generates dynamic sliding friction that forms linear microscopic striae. These fine lines mirror the fine, unique edge irregularities of the tool edge.

8. (C) P-3, Q-1, R-4, S-2
Pry bars act through mechanical leverage, generating combination marks containing impressed leverage and sliding striations. Saws produce distinct cut channels known as kerf marks during cutting actions. Wire cutters utilize opposing jaws to create pinch or shear marks on metal wires. Hammers strike surfaces directly to form distinct three-dimensional compression or impressed tool marks.

9. (D) Pinch and shear mark
Pinch and shear marks occur when opposing cutting blades or jaws press inward from both sides until the object yields and breaks. This action compresses the substrate while shearing through its cross-section. Tools like wire cutters

Click Here to Buy book on Flipkart

(D) To chemically neutralize residual alkaline or acid solvents deposited during theft

72. Which of the following is NOT an example of a tool mark?
(A) A deep physical dent left by a heavy steel hammer on a plaster wall surface
(B) Fine microscopic scratches left on internal tumblers by picking tools
(C) A bloody fingerprint left on a screwdriver handle
(D) A clean cut produced across a hardened steel padlock shackle by a cutter

73. A negative impression made by pressing a suspect's shoe into an impressionable material like bio-foam is an example of creating a:
(A) Latent friction ridge impression
(B) Unintentional class deviation pattern
(C) Microscopic tool mark striation surface
(D) Known standard test impression

74. Which of the following actions at a crime scene would be classified as a critical error in evidence handling?
(A) Inserting the suspect tool into the crime scene mark
(B) Photographing evidence tool mark impressions prior to applying chemical casting compounds
(C) Selecting dental stone over plaster of Paris for recovering three-dimensional soil marks
(D) Securely packaging recovered physical tools within rigid protective transport containers

75. Consider the following statements about bite mark analysis limitations:
I. Skin is highly elastic and distorts easily under pressure.
II. Bite marks on living victims undergo inflammatory changes over time.
III. Human dentition never changes throughout an adult's life.
IV. The position of the victim's body during biting differs from the position during examination.
Which of the above statements identify the correct limitations?
(A) I, II, and III
(B) I, II, and IV
(C) II, III, and IV
(D) I, III, and IV

NODIA

76. In sequential unmasking, a technique used to mitigate cognitive bias in forensic laboratories, the examiner should:
(A) Examine suspect tools and test marks prior to analyzing crime scene physical evidence
(B) Examine scene marks before viewing suspect tools or tests
(C) Review investigating officer summaries and crime theories before conducting laboratory testing
(D) Side-by-side comparison of scene evidence and suspect tools from initial examination phase

77. Which of the following is an example of an impressed tool mark?
(A) Stamping a serial number into firearm steel
(B) The sliding scrape of a pry bar pushed against a metal safe plate
(C) The severed cut end of flexible copper wire snipped using wire pliers
(D) The continuous kerf channel created by a high-speed motorized circular saw

78. Match the forensic term in List I with its definition in List II.
List I: (Forensic Term)
P. Striation
Q. Impression
R. Kerf
S. Stance
List II: (Definition)
1. The channel or groove made by a saw
2. The track width of a vehicle
3. Parallel scratch marks caused by sliding contact
4. A dent or mark caused by direct downward pressure
(A) P-1, Q-2, R-3, S-4
(B) P-4, Q-3, R-2, S-1
(C) P-3, Q-4, R-1, S-2
(D) P-3, Q-1, R-4, S-2

79. When an examiner uses an Electrostatic Dust Print Lifter (ESDL) to recover a footprint, what is actually transferred to the lifting film?
(A) Biological DNA evidence extracted from sweat deposits left along the impression path
(B) Latent friction ridge skin details transferred directly from an unshod bare foot surface
(C) Synthetic chemical dye residues transferred from shoe upper materials during contact
(D) Dust particles adhering to the footwear pattern

mark, complete photographic documentation is mandatory. Forensic examiners photograph tool marks with an accurate scale under oblique lighting to capture fine three-dimensional detail, depth, and spatial context. This step preserves immutable visual evidence of the mark in its pristine, unaltered state.

20. (C) It creates contrasting shadows in fine impressions to reveal 3D detail
Oblique lighting involves positioning a light source at a low, acute angle relative to the surface being photographed. This directional illumination casts distinct shadows across delicate ridges, grooves, and microscopic striations, significantly enhancing contrast. As a result, fine three-dimensional topography and subtle surface details become clearly visible and sharply defined in forensic photographs.

21. (A) Silicone rubber medium (e.g., Mikrosil)
Silicone rubber compounds, such as Mikrosil, are the gold standard for casting fine tool marks in forensic laboratories. Their outstanding dimensional stability, flexibility, and exceptional detail reproduction allow them to capture minute microscopic striations without tearing upon removal. These silicone casts provide highly accurate negative replicas suitable for high-magnification comparison microscopic analysis.

22. (C) Photograph with scale under oblique light → Apply cast → Remove set cast → Package
Processing a tool mark at a crime scene requires a systematic, non-destructive sequence. First, the mark must be photographed in situ with an accurate scale under oblique lighting. Next, a suitable casting medium is applied over the impression. Once fully cured, the cast is carefully removed and securely packaged to prevent physical damage.

23. (B) Deep, 3D footwear impressions in muddy soil
Dental stone is a gypsum-based material widely preferred for recovering deep, three-dimensional physical impressions in soil, mud, or sand. Its high compressive strength, low expansion upon setting, and durability make it ideal for supporting heavy soil casts. However, it is not suited for capturing microscopic tool mark striations, where flexible silicone media excel.

24. (C) Wrapped in heavy paper to prevent damage and preserve evidence
When packaging a suspect tool for forensic submission, its working edge must be carefully protected by wrapping it in heavy paper or soft cloth before securing it. This prevents physical alteration or scratching during transport, while preserving fragile trace evidence, such as paint, wood fragments, or biological deposits, adhering to the tool surface.

25. (A) I, II, and IV
Creating laboratory test marks requires duplicating a suspect tool's action on soft receptive media like lead or modelling clay. The angle, applied force, and contact pressure significantly influence the width, depth, and spacing of resulting microscopic striations. Consequently, forensic examiners must carefully produce multiple test marks across varying operational angles to achieve an accurate microscopic comparison.

26. (A) Comparison Microscope
The comparison microscope is the standard optical instrument used for simultaneous side-by-side analysis of tool mark casts and test impressions. It connects two independent compound microscopes through an optical bridge, presenting two separate images side by side across a split screen. This allows examiners to meticulously align and match microscopic striations across samples.

27. (B) Comparison Microscope
An optical bridge is a specialized prism assembly that joins two distinct optical paths into a single binocular viewing head within a comparison microscope. By merging light beams from two separate stages, the optical bridge creates a split-field view, enabling forensic experts to directly align and compare microscopic tool mark striations, bullets, or fibers.

NODIA

28. (B) Consecutive Matching Striae
In tool mark examination, CMS stands for Consecutive Matching Striae. It is an objective quantitative method used to evaluate microscopic line patterns on striated tool marks. By establishing defined criteria for continuous matching lines, CMS provides a standardized, empirical framework for forensic scientists to support individualization conclusions and reduce subjective bias.

soft metal tool.
Reason (R): The softer tool will undergo deformation or damage upon striking the harder surface, failing to transfer its microscopic individual characteristics clearly.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

89. In a case where a vehicle's chassis number has been altered by over-stamping (stamping new numbers directly over the original ones), what is the most significant challenge in chemical restoration?
(A) The physical metal substrate becomes chemically immune to standard acid etching reagents
(B) Over-stamping permanently reverses intrinsic magnetic polarity across underlying steel layers
(C) New stamping eradicates historical strain zones without creating secondary deformation regions
(D) Overlapping deformation zones render etched images illegible

90. Which of the following statements about capturing tool marks via photography is most appropriate?
(A) Photographs must include a scale and use oblique light
(B) Only overall spatial and mid-range contextual photographs are required for complete evidence documentation
(C) Flash illumination should always be directed perpendicular to mark surfaces to eliminate unwanted shadows
(D) High-resolution digital photography can serve as a complete scientific substitute for silicone casting

Downloaded from www.pdf.tube

38. (D) Magnetic particle testing
Magnetic particle testing is a non-destructive method that should be attempted before applying corrosive chemical etching reagents. When a ferromagnetic steel chassis is magnetized, magnetic flux leaks around sub-surface strain zones caused by original stamping. Applying fine magnetic particles highlights these flux leakages, temporarily visualizing the obliterated digits without permanently altering the substrate.

39. (B) Photograph and document the number immediately before it fades
Restored serial numbers during chemical etching are often transient and can quickly fade, darken, or degrade as chemical oxidation continues. Immediate photographic documentation under optimal lighting is the single most critical step once numbers appear. Visual recording ensures that permanent, admissible evidence is preserved before surface over-etching or oxidation obscures the digits again.

40. (C) A distinct cut from stepping on broken glass
An individual characteristic in footwear evidence results from random, unpredictable events that occur during wear, such as cuts, gouges, stone holds, or embedded objects. A distinct cut caused by broken glass is unique to that specific shoe sole. In contrast, tread design, shoe size, and manufacturer logos represent mass-produced class characteristics.

41. (D) Electrostatic Dust Print Lifter (ESDL)
Two-dimensional footwear prints composed of dry particulate dust on non-conductive, smooth surfaces are best recovered using an Electrostatic Dust Print Lifter (ESDL). The device applies a high-voltage electrostatic charge across a specialized lifting film, causing charged dust particles to migrate and adhere to the film without disturbing delicate pattern geometry or details.

42. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Dental stone is superior to Plaster of Paris for casting three-dimensional impressions in soil because of its physical properties. It possesses greater compressive strength, minimal setting expansion, and a finer grain structure that accurately replicates minute tread details. These characteristics make Dental Stone the standard choice for forensic footwear and tyre impression casting.

NODIA

43. (B) A light spray of aerosol fixative to stabilize loose soil
Before pouring heavy casting material into loose, dry sand or powder, the fragile impression must be structurally stabilized. Applying a light, fine mist of aerosol fixative or hairspray binds loose surface particles together without altering fine features. Once dry, this protective shell prevents the impression from washing away or collapsing when dental stone is poured.

44. (B) Snow Print Wax
Snow Print Wax is a specialized red or aerosol wax product used to prepare footwear impressions in snow prior to casting. When sprayed over snow, it coats the fragile surface, capturing detail while providing structural reinforcement. The wax layer acts as an insulating thermal barrier, preventing exothermic heat from setting dental stone from melting snow.

45. (A) 4, 1, 3, 2
Forensic footwear analysis follows a methodical progression. First, the crime scene impression is evaluated for class and individual characteristics. Next, the suspect's known shoe is examined for class traits. Standard test impressions of the suspect shoe are then produced in the laboratory. Finally, the scene impression is systematically compared against these test impressions.

46. (C) Sole wear patterns caused by walking gait (inward/outward roll)
Pronation and supination describe biomechanical variations in human walking gait. Pronation involves an inward rolling motion of the foot during stride, leading to pronounced wear along the medial border of the shoe sole. Supination refers to an outward rolling motion, producing wear along the lateral edge. Forensic examiners evaluate these wear trends during gait analysis.

47. (D) Bio-foam (a compressible foam block)
Bio-foam, a high-density compressible floral or impression foam, is widely used in forensic laboratories to capture three-dimensional standard impressions of a suspect's shoe. When the shoe is pressed into bio-foam, it produces a clear, durable three-dimensional impression recording depth, tread profile, and wear

or bolt cutters typical leave pinch and shear patterns characterized by double-sided opposed cut margins on severed ends.

10. (A) A single mark exhibiting both impressed and striated characteristics
A combination tool mark occurs when a tool creates an impression while simultaneously sliding across a substrate, incorporating both impressed and striated features within a single mark. This commonly happens during prying operations where an instrument first bites into a surface under compressive force and then pivots or slides under high mechanical leverage.

11. (B) Grip objects tightly, leaving opposing jaw impressions
Pliers and wrenches function by clamping around objects with mechanical force, creating distinctive indented marks from their serrated or smooth jaws. When applied with significant pressure, these tools press their jaw patterns directly into the gripped surface. The resulting marks primarily exhibit opposing jaw impressions that reflect tool size, teeth spacing, and orientation.

12. (A) I and II only
Saws create a distinct cut channel known as a kerf during cutting, which provides critical dimensional information regarding blade thickness and tooth set. Microscopic striations left on kerf walls by individual saw teeth contain valuable micro-features that are frequently used in forensic comparison microscopy to link a cut surface to a suspect saw.

13. (A) Silicone casting of the interior hole to replicate striations
Drill bits leave interior rotational striae and circular tool marks deep within drilled holes during forced breaches. Applying a flexible silicone rubber casting material allows forensic examiners to accurately replicate the internal microscopic geometry and rotational striations without damaging the original surface. The resulting cast is subsequently analyzed under a comparison microscope against known test marks.

14. (C) A knife blade drawn cleanly across a surface
Slicing marks are produced when a sharp-edged instrument like a knife blade glides across a softer substrate. The clean sliding action cuts the material while transferring microscopic parallel striations from tiny manufacturing defects along the blade edge. These fine, linear striae reflect the specific microscopic edge profile of the cutting instrument used during the crime.

15. (D) A bolt cutter
Bolt cutters feature two heavy opposing jaws designed to sever thick metal bars or lock shackles under intense mechanical force. When applied to a padlock shackle, the opposing blades compress and shear the metal from opposite directions, leaving deep, characteristically V-shaped indented cuts and shear margins on both sides of the cut line.

16. (C) To detect microscopic scratches on internal pins left by picking tools
Lock picking involves manipulating internal lock mechanism pins using specialized picks and tension wrenches. These metal instruments scrape against soft brass pins and cylinder walls, leaving fine, diagnostic microscopic scratches. Examining the internal lock components reveals physical evidence of unauthorized mechanical picking, helping determine whether physical force or covert entry methods were employed.

17. (B) Impressed and striated pry bar leverage marks on the metal skin
Safe peeling is a mechanical attack method where heavy prying tools, such as crowbars or cold chisels, are driven between the outer metal casing and frame to rip open outer steel sheets. This continuous leverage action leaves prominent combination marks featuring heavy static impressed indentations and extensive dynamic striated scrape marks along torn edges.

18. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Forensic protocol strictly prohibits inserting a suspect tool directly into a crime scene tool mark. Attempting a physical test-fit risks altering delicate microscopic striations, creating new artifacts, or transferring trace evidence between the tool and substrate. Test marks must always be produced separately in the laboratory on soft test materials for comparative microscopic analysis.

19. (A) Documenting through scaled photography with oblique light
Before undertaking any destructive recovery, chemical treatment, or physical casting of a tool

Click Here to Buy book on Amazon

epithelial cells and saliva containing nuclear and mitochondrial DNA are deposited across the skin surface. Recovering these biological traces through sterile cotton swabbing provides crucial DNA evidence for genetic profiling and suspect identification.

58. (A) I and II only
Human bite marks on skin typically form U-shaped or semi-circular patterns caused by dental arches. Forensic documentation requires capturing these marks alongside an official ABFO No. 2 scale under perpendicular lighting. Because living skin is dynamic and elastic, bite mark dimensions alter over time due to swelling, healing, and post-injury physiological changes.

59. (B) ABFO No. 2 scale
The ABFO No. 2 scale is an L-shaped metric ruler specifically designed by the American Board of Forensic Odontology for documenting bite marks and physical injuries. It incorporates millimeter graduations, crosshair targets for perspective distortion correction, and neutral gray reference bars, ensuring precise dimensional scaling during subsequent forensic photographic analysis and comparison.

60. (B) Reassembling broken or torn pieces to prove original continuity
Physical fit, also known as fracture matching, is the process of reassembling fractured, torn, or severed physical items to demonstrate that they once formed a single continuous object. By matching random surface contours, microscopic fracture lines, and structural margin irregularities, forensic scientists establish conclusive proof that separate pieces originated from the exact same source.

61. (A) A physical fit between two torn paper pieces
A physical fracture fit provides the highest level of forensic individualization because random, unpredictable fracture margins cannot be duplicated. Reassembling two matching pieces of torn paper, broken glass, or fractured plastic establishes conclusive proof of common origin. Chemical comparisons and class traits only show general similarity, whereas physical fit offers definitive individual identification.

62. (D) I, II, III, and IV
Fracture matching can be applied to any solid material that undergoes random mechanical failure or tearing. Headlamp glass, masking tape, sheared steel bolts, and fractured wooden bats all exhibit unique, irregular separation boundaries. When matched along complementary fracture surfaces, all four evidence categories can yield definitive individualizations linking questioned fragments to known items.

63. (D) Wallner lines (Rib marks)
Wallner lines, also known as rib marks, are curved, microscopic stress ridges visible on the fracture edges of broken glass. They form perpendicular to the surface where the crack originated and curve parallel to the opposite side. Examining these delicate fracture features allows forensic scientists to determine force direction and perform precise fracture matching.

NODIA

64. (C) Plastic garbage bags
Extrusion marks are continuous parallel striations formed on polymer films as molten plastic is forced through a die during manufacturing. In forensic investigations, matching extrusion lines along plastic garbage bags or films provides strong class and subclass evidence connecting rolls or batches of bags recovered at crime scenes to suspect locations.

65. (B) Another tool producing the mark is a practical impossibility.
A formal conclusion of identification in tool mark examination signifies that the degree of agreement between microscopic individual characteristics exceeds what could occur by chance. Stating that a suspect tool produced a mark indicates that the probability of another tool creating the exact same set of microscopic striations is considered a practical impossibility by experts.

66. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Heavy, continuous tool use alters the microscopic surface profile of its working edge over time through physical wear, chipping, and abrasion. These mechanical changes destroy or modify pre-existing individual characteristics. Consequently, an older tool mark left at a crime scene may no longer match test impressions made after prolonged, heavy tool usage.

67. (A) Inconclusive
The Association of Firearm and Tool Mark Examiners (AFTE) formally recognizes

(A) 4
(B) 5
(C) 7
(D) 9

27. While the OSI model is a theoretical reference, the practical model that governs the modern Internet is the TCP/IP model. How many layers are typically defined in the standard TCP/IP model?
(A) 3 layers
(B) 4 layers
(C) 6 layers
(D) 7 layers

28. In the context of IP addressing, an IPv4 address consists of how many bits?
(A) 16 bits
(B) 32 bits
(C) 64 bits
(D) 128 bits

29. Given below are two statements, one labelled as Assertion (A) and the other as Reason (R).
Assertion (A): The global transition from IPv4 to IPv6 was necessitated to overcome the imminent IP address exhaustion problem.
Reason (R): IPv6 utilizes a 128-bit address space, providing vastly more unique IP addresses than the 32-bit IPv4 scheme.
Select the correct answer from the options given below:
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

30. A Media Access Control (MAC) address is a unique identifier assigned to a network interface controller. What is the standard length and format of a MAC address?
(A) 32 bits, expressed in dotted-decimal format
(B) 48 bits, expressed in hexadecimal format
(C) 64 bits, expressed in octal format
(D) 128 bits, expressed in alphanumeric format

31. Which of the following represents the correct sequence of the first four layers of the OSI reference model, starting from the lowest layer (Layer 1) to Layer 4?
(A) Physical Layer, Network Layer, Data Link Layer, Transport Layer
(B) Physical Layer, Data Link Layer, Network Layer, Transport Layer
(C) Data Link Layer, Physical Layer, Transport Layer, Network Layer
(D) Network Layer, Data Link Layer, Physical Layer, Session Layer

32. What is the primary function of the Domain Name System (DNS) in computer networks?
(A) To encrypt all web traffic transmitted between a client browser and a target web server.
(B) To dynamically assign temporary IP addresses to new host devices joining a local area network.
(C) To translate domain names into numerical IP addresses.
(D) To continuously filter malicious incoming network traffic before it reaches a private internal network.

33. The HTTPS protocol ensures that data transferred between a user's web browser and a website is secure. Which underlying technology provides the encryption for HTTPS?
(A) File Transfer Protocol (FTP) application standard
(B) TLS / SSL encryption technology
(C) Simple Mail Transfer Protocol (SMTP) standard
(D) Internet Control Message Protocol (ICMP) system

34. Which standard network protocol is specifically designed for the reliable transfer of computer files between a client and server on a computer network?
(A) HTTP
(B) SMTP
(C) DNS
(D) FTP

35. In internet email architecture, which protocol is primarily used by mail clients to send outgoing email messages to a mail server?
(A) SMTP (Simple Mail Transfer Protocol)
(B) IMAP (Internet Message Access Protocol)
(C) POP3 (Post Office Protocol version 3)
(D) SNMP (Simple Network Management Protocol)

36. An organization that provides services for accessing, using, or participating in the Internet is known by which abbreviation?

Downloaded from www.pdf.tube

remain completely objective and uninfluenced by external expectation.

77. (A) Stamping a serial number into firearm steel
An impressed tool mark forms when an instrument exerts perpendicular compressive force onto a softer surface without lateral sliding motion. Stamping serial numbers into firearm steel presses rigid steel dies into the metal surface, creating three-dimensional indented impressions. In contrast, sliding scrapes, wire cutting, and saw cuts produce striated dynamic tool marks.

78. (C) P-3, Q-4, R-1, S-2
Striations are microscopic parallel scratches caused by sliding contact between surfaces. Impressions are indented marks produced by direct perpendicular force. A kerf is the cut channel or groove left behind by a saw blade. Stance refers to the vehicle track width, defined as the distance between opposing tyre centerlines on an axle.

79. (D) Dust particles adhering to the footwear pattern
An Electrostatic Dust Print Lifter (ESDL) works by applying a high-voltage charge across a conductive lifting sheet placed over a dry dust impression. The electrostatic field draws loose dust particles directly off the substrate surface, binding them to the underside of the lifting film. This preserves the two-dimensional dust pattern for detailed examination.

80. (C) It automatically calculates the statistical probability of a tool mark match.
A comparison microscope is an optical device featuring two objectives connected by an optical bridge to present a side-by-side view of two objects. It requires manual alignment, visual inspection, and qualitative evaluation by a trained expert. It does not possess automated statistical calculation software or automated decision-making capabilities during microscopic physical comparisons.

81. (D) I, II, and III
The Association of Firearm and Tool Mark Examiners (AFTE) standard recognizes three primary outcome conclusions during physical comparisons: Identification (positive match), Exclusion (negative match or elimination), and Inconclusive (insufficient individual agreement or disagreement). All three represent formally accepted conclusion categories within professional forensic laboratory practice.

82. (D) Exothermic heat during setting can melt snow impressions
A major physical limitation of dental stone in snow impression recovery is its exothermic reaction during curing. As dental stone mixes with water and hardens, it releases heat, which melts fragile snow details before the cast sets. To prevent melting, specialized protective sprays like Snow Print Wax are applied beforehand.

83. (A) A fracture fit between scene and vehicle glass
Reassembling broken glass pieces to form a physical fracture fit provides conclusive, individualized proof that the recovered fragment originated from the specific vehicle taillight. Chemical analysis, color matching, and refractive index measurements can establish class similarity, but only physical fracture matching offers definitive proof of common origin in forensic glass examination.

84. (C) Known error rates, empirical testing, and peer review
The legal Daubert standard governs the admissibility of expert scientific testimony in court. For tool mark discipline, Daubert stresses that analytical techniques must be grounded in sound scientific methodology, requiring known error rates, empirical testing, peer-reviewed studies, and standardized protocols, rather than relying solely on subjective expert opinions or general acceptance.

85. (A) 2, 4, 3, 1
Restoring serial numbers requires a strict sequential workflow. The obliterated area is first photographed to record initial conditions. The surface is then thoroughly cleaned and degreased. Next, fine abrasive paper is used to polish the metal surface to a mirror finish. Finally, Fry's Reagent is applied to etch the underlying strained metal.

86. (D) Oxidation, rust, or heavy rain prior to discovery
Environmental factors like rain, humidity, atmospheric oxidation, and rust can severely degrade physical tool marks exposed at crime scenes. Water erosion washes away fine surface details, while rust formation degrades delicate

NODIA

four standardized conclusion categories for microscopic examinations: Identification, Inconclusive, Elimination, and Unsuitable for comparison. "Inconclusive" applies when class traits match but individual characteristics lack sufficient quality or quantity to confirm or exclude a common origin between questioned and test samples.

68. (C) Oxidation destroys fine microscopic individual striations
Severe environmental rust and oxidation degrade metal surfaces by stripping away fine microscopic surface features. When a steel tool rusts heavily over time, delicate individual striations on its working edge are eroded and destroyed. This loss of micro-detail prevents forensic examiners from making a conclusive side-by-side comparison with older crime scene tool mark casts.

69. (A) Secure scene → Protect mark → Inform FSL → Expert photograph/cast
First responders must follow a strict non-destructive protocol upon discovering a tool mark. The immediate priority is securing the scene to prevent contamination or damage. The physical mark is protected from environmental elements, after which forensic specialists are notified. Experts then systematically photograph the mark with scaling under oblique light before applying casting media.

70. (D) Soil displacement, flattened grass, and fluid drops
Determining vehicle travel direction relies on physical trace indicators left along tyre pathways. Directional evidence includes forward soil splash patterns, the direction in which vegetation is flattened, wave-like soil ridges pushed forward by rolling wheels, and the teardrop shape of leaking fluid droplets pointing toward the direction of travel during vehicle motion.

71. (B) To clean grease so etching acid reacts evenly with metal
Engine blocks are frequently coated with dirt, oil, and heavy grease that insulate the metal substrate from chemical reagents. Applying a degreasing solvent cleans the surface, allowing chemical etching acids to make direct, uniform contact with the metal lattice. This step ensures consistent, controlled chemical etching across both strained and unstrained regions.

72. (C) A bloody fingerprint left on a screwdriver handle
A tool mark is defined as an impression, cut, gouge, or striation produced when a hard instrument contacts a softer surface. Dents from hammers, internal tumbler scratches from lock picks, and cut padlock shackle ends are classic tool marks. Conversely, a bloody fingerprint is friction ridge biological trace evidence, not a mechanical tool mark.

73. (D) Known standard test impression
Pressing a suspect's shoe into bio-foam or soft clay in a controlled environment creates a known standard test impression. Forensic examiners generate these benchmark impressions to capture the true dimensions, tread geometry, and individual wear traits of the suspect shoe, allowing direct side-by-side comparison against questioned impressions recovered from crime scenes.

74. (A) Inserting the suspect tool into the crime scene mark
Directly inserting a suspect tool into a crime scene impression is a critical error in evidence handling. This action irreversibly alters microscopic striations within the mark, creates artificial scrape marks, and transfers trace materials between the tool and substrate. Such contamination destroys the scientific integrity of the evidence and invalidates subsequent laboratory comparisons.

75. (B) I, II, and IV
Bite mark analysis is constrained by several physical factors, including the extreme elasticity of skin, post-injury tissue swelling, and variations between victim body position during the biting event and examination. Furthermore, adult human dentition undergoes continuous modification through wear, dental work, and extractions, meaning bite marks represent dynamic and changing evidence patterns.

76. (B) Examine scene marks before viewing suspect tools or tests
Sequential unmasking is a forensic protocol designed to minimize cognitive and confirmation bias. Under this procedure, examiners must evaluate and document all microscopic details of questioned scene evidence before being exposed to reference samples, suspect tools, or case context. This ensures that observations

Click Here to Buy book on Flipkart

CHAPTER 31

Basics of Computers, Networks and Cyber Crimes

1. Which of the following components are considered the primary internal building blocks of a Central Processing Unit (CPU) in a computer system?
(A) Random Access Memory, Control Unit, and Hard Disk
(B) Control Unit, Arithmetic Logic Unit, and Registers
(C) Arithmetic Logic Unit, Motherboard, and Cache
(D) Read Only Memory, Arithmetic Logic Unit, and Transistors

2. Which of the following statements correctly distinguishes primary storage from secondary storage in a computer system?
(A) Primary storage is non-volatile, whereas secondary storage is volatile.
(B) Primary storage has a much larger storage capacity than secondary storage.
(C) Primary storage includes Hard Disk Drives, whereas secondary storage includes RAM.
(D) Primary storage is directly accessible by the CPU, whereas secondary storage is not directly accessible.

3. Solid State Drives (SSDs) offer faster data access speeds compared to traditional Hard Disk Drives (HDDs). What is the primary technological reason for this difference?
(A) SSDs store data using non-volatile NAND flash memory chips with no moving mechanical parts.
(B) SSDs use faster spinning magnetic platters.
(C) SSDs utilize optical laser technology to read data.
(D) SSDs connect directly to the CPU's internal registers.

4. In a digital forensic laboratory, an examiner uses a flatbed scanner to create a high-resolution digital image of a forged questioned document. How is a scanner classified among computer hardware?
(A) Processing device
(B) Output device
(C) Input device
(D) Storage device

5. Which of the following hardware components is solely used as an output device in a computer system?
(A) Graphic plotter
(B) Touch screen display
(C) Optical Character Reader (OCR)
(D) Web camera

6. Consider the following statements regarding computer storage media:
I. CD-ROM is an example of magnetic storage media.
II. USB flash drives utilize electrically erasable programmable read-only memory (EEPROM) technology.
III. Blu-ray discs have a higher storage capacity than standard DVDs due to the use of a shorter wavelength blue-violet laser.
Which of the above statement(s) is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

7. Hard Disk Drives (HDDs) store digital data on circular disks coated with a magnetic material. What are the concentric circles on these disks formally called?
(A) Sectors
(B) Tracks
(C) Cylinders
(D) Clusters

8. A forensic scientist installs a specialized ballistics analysis software on a laboratory workstation. Under which software category does this specific program fall?
(A) System software
(B) Utility software
(C) Application software

Downloaded from www.pdf.tube

(D) Firmware

9. Given below are two statements, one labelled as Assertion (A) and the other as Reason (R).
Assertion (A): Cache memory is used to bridge the processing speed gap between the Central Processing Unit (CPU) and the Main Memory (RAM).
Reason (R): Cache memory stores frequently accessed data and instructions because it operates significantly faster than standard dynamic RAM.
Select the correct answer from the options given below:
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

10. Consider the following computer data storage units:
1. Gigabyte (GB)
2. Megabyte (MB)
3. Terabyte (TB)
4. Kilobyte (KB)

Which of the following options represents the correct order of these units arranged from the smallest capacity to the largest capacity?
(A) 4, 2, 1, 3
(B) 4, 1, 2, 3
(C) 2, 4, 1, 3
(D) 1, 2, 4, 3

11. Which of the following is NOT a primary function of an Operating System (OS)?
(A) Memory management
(B) Antivirus signature updating
(C) File system management
(D) Process and thread management

12. Linux is an operating system widely used in network servers and cybersecurity environments. What fundamental characteristic distinguishes the Linux operating system from Microsoft Windows?
(A) Linux relies entirely on cloud processing rather than local system resources.
(B) Linux is open-source, while Windows is proprietary software.
(C) Linux cannot execute graphical user interface applications natively.
(D) Linux does not utilize a standardized file system hierarchy structure.

13. When a computer is powered on, it performs a diagnostic testing sequence to ensure that essential hardware components are functioning properly before loading the operating system. What is this initialization sequence called?
(A) Power-On Self-Test (POST)
(B) Bootstrap Loader
(C) Disk Defragmentation
(D) System Configuration Utility

NODIA

14. Consider the following statements about operating systems:
I. macOS is developed by Apple and is built upon a Unix-based foundation.
II. A graphical user interface (GUI) uses windows, icons, and menus to interact with users.
III. The operating system kernel directly manages the hardware components.
IV. Microsoft Windows is considered open-source system software.
Which of the above statement(s) is/are INCORRECT?
(A) I and III
(B) II only
(C) IV only
(D) III and IV

15. In modern computer systems, UEFI has largely replaced the legacy BIOS interface. What does the acronym UEFI stand for?
(A) Universal Executable File Interface
(B) Unified External Format Integrator
(C) Universal Extensible Firmware Integrator
(D) Unified Extensible Firmware Interface

16. In digital computing, all text, images, and forensic data are ultimately processed as combinations of 0s and 1s. What is this base-2 number system called?
(A) Decimal system
(B) Hexadecimal system
(C) Binary system
(D) Octal system

17. In computer memory and data representation architecture, a group of exactly 4 bits is commonly referred to as a:
(A) Byte
(B) Nibble
(C) Word
(D) Block

18. A collection of computers and computing devices connected together to share resources and communicate is defined as a computer network. Which of the following hardware components is essential to physically connect a computer to a local wired network?
(A) Video Graphics Array (VGA) adapter
(B) Sound card
(C) Static RAM chip
(D) Network Interface Card (NIC)

19. Match the network types in List I with their typical coverage area in List II.
List I: (Network Type)
P. PAN
Q. LAN
R. MAN
S. WAN
List II: (Coverage Area)
1. A single building or laboratory campus
2. Across multiple cities, countries, or globally
3. An entire city or metropolitan region
4. Within a few meters around an individual user
Select the correct answer using the codes given below:
(A) P-4, Q-1, R-3, S-2
(B) P-1, Q-4, R-3, S-2
(C) P-4, Q-3, R-1, S-2
(D) P-1, Q-2, R-3, S-4

20. In which standard network topology is every computer and network device connected to a single central cable that acts as a shared communication medium?
(A) Star topology
(B) Ring topology
(C) Bus topology
(D) Mesh topology

21. Which network topology relies on a central connection point, such as a hub or a switch, to connect all peripheral nodes?
(A) Star topology
(B) Ring topology
(C) Bus topology
(D) Full Mesh topology

22. In a computer network environment, what is the primary function of a Router?
(A) To convert analog signals from a telephone line into digital computer signals.
(B) To act as a central hub that broadcasts incoming data to all connected devices on a single LAN.
(C) To provide temporary power backup to the network servers.
(D) To forward data packets between different computer networks based on IP addresses.

23. A network switch is considered more intelligent and efficient than a basic network hub. Why is this the case?
(A) A switch connects computers using wireless signals, whereas a hub strictly requires physical ethernet cabling.
(B) A switch uses MAC addresses to forward frames directly to the target device.
(C) A switch automatically translates private local IP addresses into public IP addresses for internet access.
(D) A switch provides active built-in antivirus and malware scanning for all incoming network data traffic.

24. Which networking device derives its name from its primary function of modulating digital signals into analog signals for transmission over telephone lines, and demodulating incoming analog signals back into digital format?
(A) Repeater
(B) Router
(C) Modem
(D) Gateway

25. Consider the following statements regarding network devices:
I. A network switch forwards incoming data packets to all connected devices simultaneously, regardless of the destination MAC address.
II. A router operates at the Network Layer (Layer 3) of the OSI model.
III. A repeater is used to amplify or regenerate signals to extend the distance a network can reach.
Which of the above statement(s) is/are INCORRECT?
(A) I only
(B) II and III only
(C) III only
(D) I and II only

26. The Open Systems Interconnection (OSI) reference model is a conceptual framework used to describe the functions of a networking system. How many distinct layers does the OSI model contain?

Click Here to Buy book on Amazon

44. Consider the following statements regarding cloud computing models:
I. Software as a Service (SaaS) delivers software applications over the internet on a subscription basis.
II. Platform as a Service (PaaS) provides hardware and software tools primarily for application developers.
III. Infrastructure as a Service (IaaS) offers virtualized computing resources like servers and storage over the internet.
IV. Cloud computing strictly limits users from accessing data remotely.
Which of the above statement(s) is/are correct?
(A) I, II and IV
(B) I, II and III
(C) II, III and IV
(D) I and III only

45. In cybersecurity, the unauthorized penetration of a computer network or system to access data or disrupt services is known as:
(A) Hacking
(B) Phishing
(C) Cyber stalking
(D) Vishing

46. The unauthorized copying, transferring, or removal of confidential information from a computer system by a malicious insider or external attacker is termed:
(A) Denial of Service (DoS)
(B) Cyber defamation
(C) Data theft
(D) Cryptojacking

47. A cybercriminal sets up a deceptive website that perfectly mimics the official portal of a major bank to capture users' login credentials and credit card numbers. This specific financial cybercrime technique is called:
(A) Hacking
(B) Cyber stalking
(C) Logic Bombing
(D) Phishing

48. When a fraudster fraudulently acquires and uses another person's personal identifying information, such as an Aadhaar number or bank details, to commit financial fraud, the crime is classified as:
(A) Cyber defamation
(B) Denial of Service
(C) Identity theft
(D) Ransomware

49. Given below are two statements, one labelled as Assertion (A) and the other as Reason (R).
Assertion (A): Cybercrimes often pose complex jurisdictional challenges for law enforcement agencies.
Reason (R): Cybercrimes are inherently borderless, allowing an attacker in one country to target a victim in another jurisdiction without physical presence.
Select the correct answer from the options given below:
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

50. Malicious software designed to cause harm to a computer system is collectively called malware. Which type of malware specifically requires a host program or file to attach itself to in order to execute and replicate?
(A) Worm
(B) Trojan Horse
(C) Spyware
(D) Virus

51. Unlike a computer virus, which type of malware is a standalone program that can autonomously self-replicate and spread across computer networks without requiring human action or a host file?
(A) Worm
(B) Trojan Horse
(C) Ransomware
(D) Keylogger

52. A user downloads what appears to be a legitimate free media player software, but upon installation, it secretly opens a backdoor for hackers to access the system. What type of malware is this?
(A) Computer Virus
(B) Network Worm
(C) Trojan Horse
(D) File infector

53. In a recent cyberattack on a hospital, all digital patient records were encrypted by an attacker who demanded payment in cryptocurrency to provide the decryption key. This is a classic example of:

NODIA

(A) WWW
(B) LAN
(C) ISP
(D) VPN

37. Match the internet protocols in List I with their primary function in List II.
List I: (Internet Protocol)
P. HTTP
Q. SMTP
R. FTP
S. DNS
List II: (Primary Function)
1. Resolving domain names to IP addresses
2. Transferring web page data across the internet
3. Sending and routing email messages
4. Uploading and downloading files between systems
Select the correct answer using the codes given below:
(A) P-2, Q-3, R-4, S-1
(B) P-4, Q-3, R-2, S-1
(C) P-2, Q-4, R-3, S-1
(D) P-3, Q-2, R-1, S-4

38. While often used interchangeably by the public, the Internet and the World Wide Web (WWW) are distinct concepts. Which statement accurately describes the relationship between them?
(A) The WWW is the physical infrastructure, while the Internet is a software application running on it.
(B) The Internet was created by Tim Berners-Lee, while the WWW was created by the US Department of Defense.
(C) The WWW utilizes MAC addresses, whereas the Internet utilizes IP addresses.
(D) The WWW is an information system of interlinked hypertext documents accessed over the Internet.

39. In cyber investigations, forensic analysts often encounter the terms "Deep Web" and "Dark Web". Which of the following defines the "Dark Web"?
(A) The public portion of the internet that is routinely indexed and made searchable by standard web search engines.
(B) An encrypted internet region requiring specialized software like Tor to access.
(C) Any standard commercial website that requires user authentication credentials to access private account data.
(D) Private internal corporate network segments that remain completely disconnected from global internet routing.

40. A forensic laboratory uses a web-based case management system hosted by a third-party provider, accessed via a web browser without installing local server software. Which cloud computing service model does this represent?
(A) Infrastructure as a Service (IaaS)
(B) Platform as a Service (PaaS)
(C) Software as a Service (SaaS)
(D) Hardware as a Service (HaaS)

41. In the context of cybercrime, how is a cybercrime legally and conceptually distinguished from traditional crime?
(A) Any criminal violation that strictly requires the physical theft or destruction of server hardware components.
(B) Any fraudulent financial scheme that is exclusively committed across international sovereign borders online.
(C) Any unlawful activity limited solely to the creation and malicious distribution of computer virus software.
(D) Any unlawful act where a computer is either the target or the instrument of the crime.

42. Cybercrimes are commonly classified into broad categories based on the target. Which of the following is an example of a cybercrime against property?
(A) Hacking a server to steal data
(B) Cyber stalking and harassment of an individual online
(C) Online defamation targeting a person's reputation
(D) Distribution of child pornography via digital channels

43. Under Section 354D of the Bharatiya Nyaya Sanhita (formerly Indian Penal Code) and relevant Information Technology Act provisions, the act of a person repeatedly monitoring a woman's internet, email, or other electronic communication without her consent constitutes which specific offense?
(A) Cyber terrorism
(B) Cyber stalking
(C) Data diddling
(D) Identity theft

Downloaded from www.pdf.tube

microscopic striations on metallic substrates. These environmental degradation processes hinder accurate laboratory comparison and compromise forensic analysis.

87. (B) Hacksaw or abrasive cutting wheel
A padlock shackle cut cleanly with a flat, smooth cross-section and parallel microscopic line patterns indicates a sawing or grinding action. Tools such as hacksaws or abrasive rotary cutting wheels cut through metal progressively, producing characteristic kerf surfaces lined with fine parallel striations along the cut plane.

88. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
When a tool made of a softer metal strikes a substantially harder substrate, the soft tool undergoes mechanical deformation, blunting, or squishing upon impact. Because the tool edge yields, it fails to cut into or mark the harder surface cleanly, preventing the clear transfer of its fine microscopic individual traits for comparison.

NODIA

89. (D) Overlapping deformation zones render etched images illegible
Over-stamping involves forcibly driving new serial numbers directly over an existing obliterated number. This secondary stamping creates complex, overlapping sub-surface strain patterns within the metal crystal lattice. When chemical etching is applied, both original and secondary strain zones react simultaneously, producing jumbled, overlapping digit images that are often illegible and uninterpretable.

90. (A) Photographs must include a scale and use oblique light
Forensic photography of tool marks requires incorporating a calibrated scale and utilizing low-angle oblique lighting. Oblique light creates contrasting shadows that highlight fine three-dimensional detail, depth, and microscopic striations across impression surfaces. A scale provides accurate dimensional verification necessary for subsequent scientific comparisons and court presentations.

(A) Ransomware
(B) Spyware
(C) Phishing
(D) Cyber defamation

54. Which specific type of spyware program secretly records every keystroke made by a user on their keyboard, often used by cybercriminals to steal passwords and credit card numbers?
(A) Logic Bomb
(B) Rootkit
(C) Adware
(D) Keylogger

55. A cyber attack that maliciously attempts to disrupt normal traffic of a targeted server, service, or network by overwhelming the target or its surrounding infrastructure with a flood of Internet traffic is known as:
(A) Man-in-the-Middle (MitM) attack
(B) Denial of Service (DoS) attack
(C) SQL Injection
(D) Cross-Site Scripting (XSS)

56. What distinguishes a Distributed Denial of Service (DDoS) attack from a standard Denial of Service (DoS) attack?
(A) A DDoS attack relies primarily on deceptive social engineering techniques, whereas a DoS attack relies strictly on specialized malware delivery.
(B) A DDoS attack targets enterprise database management systems, whereas a DoS attack targets physical hardware components and infrastructure.
(C) A DDoS attack uses multiple systems (a botnet) simultaneously, whereas a DoS attack uses a single source.
(D) A DDoS attack focuses on stealing confidential corporate data, whereas a DoS attack focuses strictly on modifying system configuration files.

57. In the context of cyber security, what term describes the psychological manipulation of people into performing actions or divulging confidential information, rather than exploiting software vulnerabilities?
(A) Reverse Engineering
(B) Cryptanalysis
(C) Penetration Testing
(D) Social Engineering

58. Match the type of malware in List I with its defining characteristic in List II.
List I: (Malware Type)
P. Ransomware
Q. Spyware
R. Trojan Horse
S. Worm
List II: (Defining Characteristic)
1. Self-replicating malware that spreads across networks autonomously
2. Encrypts user data and demands payment for the decryption key
3. Secretly monitors user activity and collects information like keystrokes
4. Disguises itself as legitimate software to trick users into executing it
Select the correct answer using the codes given below:
(A) P-2, Q-3, R-4, S-1
(B) P-2, Q-4, R-3, S-1
(C) P-3, Q-2, R-4, S-1
(D) P-4, Q-3, R-1, S-2

59. Section 66F of the Information Technology Act, 2000 prescribes punishment for acts committed with the intent to threaten the unity, integrity, security, or sovereignty of India, or to strike terror in the people, by denying access to computer resources or accessing restricted networks. This offense is known as:
(A) Cyber defamation
(B) Cyber terrorism
(C) Cyber stalking
(D) Identity theft

60. Which Indian law works in conjunction with the Information Technology Act to handle online child exploitation offenses, including the possession and transmission of child pornography?
(A) The Indian Copyright Act of 1957
(B) The POCSO Act
(C) The Negotiable Instruments Act of 1881
(D) The Indian Contract Act of 1872

61. Consider the following statements regarding cybercrimes targeting persons:
I. Cyber stalking involves repeatedly harassing and observing a person online without their consent.
II. Online defamation occurs when false statements causing reputational harm are published on digital platforms.
III. Data theft is exclusively classified as a crime against persons rather than a crime against

Click Here to Buy book on Flipkart

36. (C) ISP
Commercial and residential internet connectivity depends on telecommunication entities providing network access infrastructure. An Internet Service Provider maintains data routing hardware, backbones, and point-of-presence connections to deliver internet accessibility to subscribers. These organizations manage physical and logical network links, assigning IP addresses and routing data traffic to connect local customer networks to the wider internet.

37. (A) P-2, Q-3, R-4, S-1
Internet protocols handle distinct communication roles across network environments. Hypertext Transfer Protocol fetches and transmits web page assets. Simple Mail Transfer Protocol manages outgoing email routing between mail servers. File Transfer Protocol facilitates structured upload and download file management across hosts. Domain Name System resolves human-readable domain names into corresponding numerical IP addresses for proper network routing.

38. (D) The WWW is an information system of interlinked hypertext documents accessed over the Internet.
The Internet and World Wide Web represent distinct layers of digital communication technology. The Internet comprises the global physical network infrastructure, hardware, and routing protocols. In contrast, the World Wide Web is an application-level information system consisting of interlinked hypertext documents and multimedia resources accessed using web browsers over that underlying global network infrastructure.

39. (B) An encrypted internet region requiring specialized software like Tor to access.
Online digital content is structured into distinct accessible zones. While the public surface web is indexed by search engines and the deep web contains unindexed password-protected databases, the dark web comprises specialized encrypted network segments. Accessing dark web sites requires anonymizing overlay software like Tor, which routes traffic through encrypted node paths to maintain user and host anonymity.

40. (C) Software as a Service (SaaS)
Cloud service architectures are categorized according to the level of vendor management provided to clients. Software as a Service delivers complete application functionality directly over web browser interfaces. Subscribers access hosted applications without managing underlying operating systems, server hardware, network infrastructure, or physical storage devices, making SaaS ideal for web-hosted management solutions.

41. (D) Any unlawful act where a computer is either the target or the instrument of the crime.
Cybercrime encompasses a broad spectrum of illegal activities involving electronic processing systems and network devices. Conceptually and legally, cybercrime is defined by the functional role of computing hardware during commission. It covers offences where digital equipment acts directly as the target of an attack or serves as the primary tool utilized to perform criminal acts.

42. (A) Hacking a server to steal data
Cybercrimes are classified based on whether the primary target is an individual, property, or state entity. Digital property includes intangible electronic assets, proprietary databases, and corporate server infrastructure. Penetrating server networks without authorization to extract, compromise, or alter proprietary data represents a direct violation of digital property rights, placing it under cybercrimes against property.

43. (B) Cyber stalking
Digital harassment laws address persistent online monitoring and non-consensual tracking of individuals across electronic mediums. Under provisions like Section 354D of the Bharatiya Nyaya Sanhita and relevant IT legislation, systematically following, observing, or monitoring a person's internet activity, electronic mail, or digital communications without legitimate consent constitutes the specific offense of cyber stalking.

44. (B) I, II and III
Cloud computing models provide flexible online access to computing resources. Software as a Service delivers software online, Platform as a Service offers development tools, and Infrastructure as a Service supplies virtualized hardware resources. Claiming that cloud systems prohibit remote access contradicts cloud architecture, as facilitating remote accessibility across networks is the fundamental defining purpose of cloud computing.

NODIA

72. The IPv6 addressing system uses a 128-bit address structure. How is an IPv6 address conventionally written for human readability?
(A) Four groups of decimal numbers ranging from 0 to 255 separated by dots
(B) Six groups of two hexadecimal digits representing hardware standard separated by hyphens
(C) Eight colon-separated groups of hexadecimal digits
(D) A continuous non-delimited 128-character string consisting strictly of binary digits

73. Which of the following best describes the content found on the "Deep Web"?
(A) An encrypted network of illegal marketplaces selling illicit goods exclusively via specialized anonymizing networks.
(B) Public websites that have been censored or blocked by a national government's restrictive internet firewall.
(C) The vast physical infrastructure of undersea fiber optic cables that transport global internet communications data.
(D) Unindexed web content like private banking portals, webmail, and databases.

74. At which layer of the OSI model does a traditional network switch operate, using MAC addresses to forward frames?
(A) Physical Layer (Layer 1)
(B) Data Link Layer (Layer 2)
(C) Network Layer (Layer 3)
(D) Transport Layer (Layer 4)

75. A user enters a URL into a web browser. Which of the following represents the correct general sequence of steps used by the browser and network to retrieve the webpage?
(A) HTTP Request sent, DNS resolves domain to IP, TCP connection established, Server sends HTTP Response
(B) DNS resolves domain to IP, TCP connection established, HTTP Request sent, Server sends HTTP Response
(C) TCP connection established, DNS resolves domain to IP, Server sends HTTP Response, HTTP Request sent
(D) HTTP Request sent, TCP connection established, DNS resolves domain to IP, Server sends HTTP Response

76. The first 24 bits (3 bytes) of a MAC address are known as the OUI (Organizationally Unique Identifier). What information does the OUI provide to a forensic investigator?
(A) The exact global physical and geographic location coordinates of the host computing device.
(B) The manufacturer of the network interface card.
(C) The dynamic IP address currently assigned to the device by the local network gateway server.
(D) The primary operating system release version currently executing on the underlying hardware.

77. A cybercriminal uses automated voice messages claiming to be from the victim's bank, urging them to call a toll-free number to verify their account details. This specific form of phishing conducted over telephone systems is known as:
(A) Vishing
(B) Smishing
(C) Whaling
(D) Spoofing

78. While standard phishing involves sending mass fraudulent emails to random targets, an attack that targets specific individuals or organizations with highly personalized emails is known as:
(A) Pharming attack
(B) Vishing attack
(C) Spear phishing
(D) Baiting attack

NODIA

79. The core principles of information security are often modeled as the CIA Triad. What do the letters C, I, and A stand for in this context?
(A) Computing, Internet, Accessibility
(B) Cybercrime, Investigation, Authentication
(C) Cryptography, Identification, Authorization
(D) Confidentiality, Integrity, Availability

80. Consider the following phases of a standard boot process in a personal computer:
1. The operating system kernel is loaded into RAM and takes control.
2. The Power-On Self-Test (POST) is executed to verify hardware functionality.
3. The CPU receives power and begins executing the BIOS/UEFI firmware code.
4. The bootloader program is executed from the primary boot storage device.

Which of the following options represents the correct chronological order of these phases?
(A) 3, 2, 4, 1

(B) 2, 3, 1, 4
(C) 3, 4, 2, 1
(D) 2, 4, 3, 1

81. Consider the following statements about cyber security measures:
I. A network firewall can be implemented as hardware, software, or a combination of both to filter traffic.
II. Antivirus software relies solely on hardware configuration to detect newly created malware.
III. Data encryption converts plaintext into unreadable ciphertext to protect data confidentiality.
IV. Multi-factor authentication (MFA) requires two or more verification methods to grant system access.
Which of the above statement(s) is/are correct?
(A) I, II and III
(B) I, III and IV
(C) II, III and IV
(D) I, II, III and IV

82. In digital storage capacity calculations, 1 Megabyte (MB) is traditionally equal to how many Kilobytes (KB)?
(A) 1000 KB
(B) 1024 KB
(C) 2048 KB
(D) 1048 KB

83. What is the decimal (base-10) equivalent of the binary number 1010?
(A) 8
(B) 10
(C) 12
(D) 14

84. The hexadecimal number system, frequently used in computing to concisely represent MAC addresses and IPv6 addresses, is based on which radix (base)?
(A) Base 8
(B) Base 10
(C) Base 16
(D) Base 32

85. Given below are two statements, one labelled as Assertion (A) and the other as Reason (R).
Assertion (A): Phishing attacks are classified as a prominent form of social engineering commonly used by cybercriminals.
Reason (R): Phishing attacks exploit human psychology by tricking victims into voluntarily revealing sensitive information, rather than exploiting technical software vulnerabilities.
Select the correct answer from the options given below:
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

86. Which basic cybersecurity countermeasure protects the contents of a seized digital device from being read if the device is lost, stolen, or intercepted during transit?
(A) Disk defragmentation utility
(B) MAC address network filtering
(C) Router port forwarding rules
(D) Data encryption

87. A network of private computers infected with malicious software and controlled as a group without the owners' knowledge, often used to launch DDoS attacks, is known as a:
(A) Intranet
(B) Botnet
(C) Darknet
(D) VLAN

88. Match the cybercrimes in List I with their primary classification in List II.
List I: (Cybercrime)
P. Cyber stalking
Q. Data theft from a corporate server
R. Distributed Denial of Service (DDoS) attack
S. Credit card skimming
List II: (Primary Classification)
1. Crime against property
2. Crime against person
3. Financial cybercrime
4. Attack on system availability
Select the correct answer using the codes given below:
(A) P-2, Q-1, R-4, S-3
(B) P-1, Q-2, R-3, S-4
(C) P-2, Q-4, R-1, S-3
(D) P-3, Q-1, R-4, S-2

89. In a highly secure digital forensic network, resilience against cable failure is critical. Which network topology provides the highest level of redundancy by directly connecting every single node to every other node?

Downloaded from www.pdf.tube

(A) Centralized Star network topology
(B) Single backbone Bus network topology
(C) Circular Ring network topology
(D) Mesh topology

90. Which of the following is considered a secure protocol for connecting to a remote computer over an unsecured network, providing an encrypted command-line interface?
(A) SSH
(B) Telnet protocol
(C) File Transfer Protocol (FTP)
(D) Hypertext Transfer Protocol (HTTP)

www.nodia.in

NODIA

half of a byte and corresponding to a single hexadecimal digit in computer memory notation.

18. (D) Network Interface Card (NIC)
Establishing physical connectivity between a computing device and a wired transmission network requires specialized expansion hardware. A Network Interface Card provides the physical port for connecting network cables and converts system data into electrical or optical signals. Additionally, it contains the programmed MAC address necessary to send and receive frame traffic over physical network segments.

19. (A) P-4, Q-1, R-3, S-2
Networks are categorized by geographic coverage. Personal Area Networks operate across short distances around individuals. Local Area Networks connect devices within single buildings or localized campuses. Metropolitan Area Networks extend coverage across municipal cities. Wide Area Networks link systems across large geographic distances, including national or international regions, completing the standard structural hierarchy of network classifications.

20. (C) Bus topology
Network topologies define how physical devices interconnect within communication infrastructures. In a bus topology, all network nodes connect to a single central cable known as the bus or backbone. Data signals travel along this shared medium to all connected devices, where terminating resistors at each end prevent signal reflection and channel interference.

21. (A) Star topology
Star network configurations arrange peripheral devices around a centralized network device, such as a switch or hub. Each host node maintains a dedicated point-to-point connection to this central hub. All data traffic transmitted between network endpoints must pass through the central node, simplifying administration and isolating physical cable failures to individual peripheral connections.

22. (D) To forward data packets between different computer networks based on IP addresses.
Routers operate at the network layer of communication models to interconnect distinct network segments. These devices inspect incoming packet headers to read destination IP addresses and consult routing tables. By determining the most efficient path across networks, routers forward data packets across multiple networks to reach distant destination networks accurately and efficiently.

23. (B) A switch uses MAC addresses to forward frames directly to the target device.
Network switches inspect data link layer frames to extract hardware MAC addresses and record them in internal address tables. Unlike basic hubs that broadcast incoming data to every port, switches forward frames exclusively to the specific physical port connected to the target destination. This selective forwarding reduces domain collisions and improves overall network transmission efficiency.

24. (C) Modem
Modems facilitate communication between digital computing systems and analog transmission infrastructure like telephone lines. The device performs modulation by converting binary digital computer signals into continuous analog audio frequencies for transmission. On receiving signals, it performs demodulation to translate analog waveforms back into digital data, blending these two operations into its standard functional designation.

25. (A) I only
Switches maintain dynamic MAC address tables to route incoming network frames strictly to destination ports, avoiding widespread broadcast. In contrast, basic hubs broadcast incoming frames to all connected ports without evaluating addresses. Meanwhile, routers operate at the network layer using IP addressing, and repeaters amplify electrical or optical signals to overcome line attenuation over physical cable distances.

26. (C) 7
The Open Systems Interconnection reference model provides a standardized architectural framework for network communication design. Developed by the International Organization for Standardization, this framework divides network protocol functions into seven distinct logical layers: Physical, Data Link, Network, Transport, Session, Presentation, and Application. This structure facilitates interoperability between diverse hardware and software communication technologies.

Click Here to Buy book on Amazon

the core definition of application-level computer software.

9. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Central processing units operate at significantly higher clock frequencies than dynamic random-access memory, creating a performance bottleneck during data execution. Cache memory utilizes high-speed static memory technology placed near the processor core to hold active instructions and data. Storing frequently needed data in this high-speed buffer directly bridges the processing speed differential between execution cores and main RAM.

10. (A) 4, 2, 1, 3
Digital data measurement follows a standardized binary capacity hierarchy based on exponential byte multiples. Kilobytes represent thousands of bytes, forming the smallest measure among the listed options. Megabytes equal roughly one million bytes, followed by gigabytes at roughly one billion bytes. Terabytes represent the largest capacity unit in this group, equalling one trillion bytes or 1024 gigabytes.

11. (B) Antivirus signature updating
Operating systems manage fundamental computer resources including processor scheduling, memory allocation, storage access, and file management. Downloading software definitions or updating security signatures is an application-layer service provided by third-party security software. While operating systems facilitate the underlying network communication for updates, managing antivirus signature databases remains outside the core scope of operating system maintenance functions.

12. (B) Linux is open-source, while Windows is proprietary software.
Linux is built around an open-source architecture allowing global developers to inspect, modify, and distribute its source code freely. Proprietary operating systems maintain restricted codebases owned by commercial corporations, limiting internal software modification to authorized developers. This open licensing model provides enhanced transparency, customization capabilities, and community security auditing, distinguishing Linux fundamentally from commercial proprietary software platforms.

NODIA

13. (A) Power-On Self-Test (POST)
Initial system startup activates firmware routines stored within non-volatile system memory. The initial diagnostic routine tests critical physical hardware, including memory modules, storage interfaces, and system controllers, ensuring operational stability before booting. This initial diagnostic verification process is known as the Power-On Self-Test, establishing system integrity prior to handing operational control over to the bootloader.

14. (C) IV only
Microsoft Windows is a closed-source, proprietary operating system developed and commercialized exclusively by Microsoft Corporation. Its underlying codebase is protected by copyright and trade secret laws, prohibiting unauthorized code modification or redistributions. In contrast, macOS maintains a Unix-based kernel structure, graphical user interfaces rely on visual interaction, and operating system kernels directly control system hardware.

15. (D) Unified Extensible Firmware Interface
Modern system architectures utilize modern firmware specifications to manage hardware initialization and system boot processes. The Unified Extensible Firmware Interface replaced legacy legacy BIOS systems by offering faster boot speeds, enhanced security protocols, and support for large storage volumes. This standard interface links low-level system hardware directly to operating system loaders using standardized platform management software.

16. (C) Binary system
Digital computers use electronic switching circuits that exist in two discrete electrical states, represented symbolically as 0 and 1. This mathematical representation is known as the binary number system, or base-2 positional notation. All complex computer operations, instructions, characters, and media streams are fundamentally converted into binary bits for processing, manipulation, and storage within electronic circuits.

17. (B) Nibble
Information measurement structures rely on precise groupings of binary digits. A single binary digit is termed a bit, while eight combined bits form a standard byte. A cluster of exactly four binary digits is defined as a nibble, representing

ANSWERS

1. (B) Control Unit, Arithmetic Logic Unit, and Registers
Central processing units rely on three essential internal architectural components to execute instructions and handle data flow effectively. The control unit directs operational sequences and manages timing signals. The arithmetic logic unit performs all mathematical calculations and logical evaluations. Registers provide high-speed temporary storage locations directly within the processor for rapid instruction and data manipulation.

2. (D) Primary storage is directly accessible by the CPU, whereas secondary storage is not directly accessible.
Primary computer memory connects directly to the central processor via the system bus, enabling rapid instruction fetching and execution. In contrast, secondary storage devices require input and output channels to transfer information into primary memory before processing can occur. This direct architecture makes primary storage essential for active operation, while secondary media provides persistent long-term data preservation.

3. (A) SSDs store data using non-volatile NAND flash memory chips with no moving mechanical parts.
Solid state drives achieve superior access speeds by replacing mechanical components with integrated semiconductor arrays. Traditional drives depend on spinning magnetic platters and physical read heads, creating latency during data retrieval. Flash memory stores information electronically in silicon chips, allowing near-instantaneous read and write operations without mechanical delays, physical wear, or rotational latency.

4. (C) Input device
Input devices capture real-world data or human interactions and convert them into binary digital signals for system processing. Optical scanners capture visual information from physical documents through optical sensors, generating high-resolution digital image files. Because this equipment transmits digitized data into the computing environment without producing physical outputs or processing instructions internally, it functions strictly as input hardware.

5. (A) Graphic plotter
Output devices present processed digital data to human users or physical systems without taking in control data or user input. Graphic plotters interpret vector commands from a host system to draw detailed line art, architectural diagrams, or engineering schematics on paper. Since plotters only receive digital signals and generate external media output, they operate exclusively as output hardware.

6. (B) II and III only
Flash memory drives use non-volatile EEPROM technology to electronically write, erase, and store data without moving parts. Blu-ray systems utilize shorter 405-nanometer wavelength blue-violet lasers, allowing tighter data track spacing and significantly higher capacity than red-laser DVDs. Conversely, optical compact discs rely on laser reflectivity rather than magnetic alignment, making classification as magnetic media inaccurate.

7. (B) Tracks
Magnetic hard disk platters organize stored data within circular structural patterns across their spinning surfaces. Concentric rings extending around the central spindle are formally termed tracks. These tracks are partitioned further into smaller arc segments called sectors. Concentric tracks across multiple stacked platters form cylinders, creating a logical geometry for indexing, locating, and reading physical disk sectors efficiently.

8. (C) Application software
Application software includes programs designed to accomplish specific user tasks rather than manage underlying hardware resources. Specialized software tools created for domain-specific analyses, such as ballistics evaluation or document comparison, operate on top of an operating system. They enable end users to perform targeted operational workflows, fulfilling

Downloaded from www.pdf.tube

27. (B) 4 layers
Practical internet operations rely on the TCP/IP suite rather than conceptual reference models. The architecture organizes network functions into four functional layers: Network Access, Internet, Transport, and Application. By consolidating low-level media access and high-level session formatting, this four-layer model delivers a streamlined operational structure optimized for real-world packet routing across global networks.

28. (B) 32 bits
Internet Protocol version 4 addresses serve as logical network identifiers for host interfaces across connected networks. An IPv4 address consists of a 32-bit binary number, typically structured into four 8-bit octets. Human-readable notation expresses these four octets in dotted-decimal format, providing approximately 4.3 billion unique binary address combinations across global routing tables.

29. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
The rapid proliferation of internet-connected computing devices exhausted the 32-bit address pool available under IPv4 standards. Transitioning to IPv6 expanded address sizes to 128 bits, yielding an exponentially larger numerical address space. This vast address capacity resolves IP address depletion issues, ensuring every global network interface can receive a unique public routing address.

30. (B) 48 bits, expressed in hexadecimal format
Media Access Control addresses provide unique hardware identification for network interface controllers. A MAC address contains 48 bits of binary information, permanently burned into network interface devices during manufacturing. Standard human representation displays these 48 bits as twelve hexadecimal digits, organized into six paired groups separated by colons or hyphens to ensure physical layer identifier clarity.

31. (B) Physical Layer, Data Link Layer, Network Layer, Transport Layer
The Open Systems Interconnection model structures network functionality into bottom-up hierarchical tiers. Layer 1, the Physical Layer, handles raw bit transmission across physical media. Layer 2, the Data Link Layer, manages node-to-node frame delivery. Layer 3, the Network Layer, executes logical IP packet routing. Layer 4, the Transport Layer, ensures end-to-end communication reliability and segment flow control.

32. (C) To translate domain names into numerical IP addresses.
Internet routing relies strictly on numerical IP addresses to locate network servers, whereas human users remember alphabetic web domain names easily. The Domain Name System functions as a distributed directory service that translates human-friendly hostnames into corresponding numerical IP addresses. This automated translation allows web browsers to establish underlying network connections using accurate destination addresses.

33. (B) TLS / SSL encryption technology
Secure web communications rely on cryptographic protocols to safeguard sensitive data in transit across public networks. Hypertext Transfer Protocol Secure layers standard HTTP communications over Transport Layer Security or legacy Secure Sockets Layer protocols. This cryptographic integration encrypts request and response data streams, ensuring confidentiality, server authentication, and message integrity during web sessions.

34. (D) FTP
File transfer operations across network environments require protocols designed specifically for reliable file handling. The File Transfer Protocol operates at the application layer to enable users to upload, download, and manage files between network hosts. Utilizing separate control and data connections, it establishes structured communications necessary for transferring complete digital files between client and server architectures.

35. (A) SMTP (Simple Mail Transfer Protocol)
Electronic mail architecture relies on specialized application protocols for sending and receiving messages across servers. The Simple Mail Transfer Protocol acts as the primary standard for pushing outgoing emails from mail clients to mail servers and routing messages between intermediate mail transfer agents. Receiving protocols like IMAP or POP3 are subsequently used by recipients to retrieve those messages.

NODIA

property.

Which of the above statement(s) is/are correct?

(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

62. In the context of basic cyber security countermeasures, what is the primary role of a Firewall?

(A) To physically prevent unauthorized laboratory personnel from entering restricted server room facilities.
(B) To automatically and continuously back up digital forensic evidence data to a remote cloud server.
(C) To filter network traffic based on security rules.
(D) To scan local hard drives for dormant computer virus files and automatically quarantine or remove them.

63. Which cybersecurity software countermeasure works by scanning files and system memory for known malware signatures or suspicious heuristic behaviors?

(A) Virtual Private Network (VPN) tunnel
(B) Managed Network Switch device
(C) MAC address network filtering system
(D) Antivirus software

64. A specific type of computer virus infects the very first sector of a hard drive, which contains the code necessary to start the operating system. What is this virus type called?

(A) Macro virus
(B) File infector virus
(C) Boot sector virus
(D) Polymorphic virus

65. The primary printed circuit board in a computer that connects the CPU, memory, and external connectors is called the:

(A) Daughterboard
(B) Motherboard
(C) Backplane
(D) Processor socket

66. When conducting data extraction from a seized mobile phone, a forensic examiner is dealing primarily with which type of internal storage technology?

(A) Magnetic tape
(B) Optical phase change
(C) Hard disk platters
(D) NAND flash memory

67. On a traditional Hard Disk Drive (HDD), the read/write mechanism that moves across the spinning platters to access data is called the:

(A) Actuator arm
(B) Spindle motor
(C) Cylinder
(D) Logic board

68. Which of the following optical storage media utilizes a blue-violet laser to read and write data, allowing for a standard single-layer storage capacity of approximately 25 GB?

(A) Compact Disc Read-Only Memory (CD-ROM)
(B) Digital Versatile Disc Recordable (DVD-R)
(C) Blu-ray Disc
(D) Magnetic Floppy Disk Drive Media

69. Which type of software is designed specifically to help configure, optimize, or maintain the computer system, with examples including disk defragmenters and system backup tools?

(A) Utility software
(B) Application software
(C) Operating system kernel
(D) Presentation software

70. In modern Microsoft Windows operating systems (like Windows 10 and 11), what is the default and most commonly used file system for the primary hard drive?

(A) File Allocation Table 32 (FAT32)
(B) Fourth Extended File System (ext4)
(C) Hierarchical File System Plus (HFSzzz+)
(D) NTFS

71. Consider the following statements regarding network addressing:

I. A MAC address is a 48-bit hardware address assigned to a network interface card by the manufacturer.
II. An IPv4 address is typically represented in an 8-group hexadecimal format.
III. IPv6 was introduced primarily to provide a significantly larger pool of available IP addresses.

Which of the above statement(s) is/are correct?

(A) I and II only
(B) I and III only
(C) II and III only
(D) I, II and III

Click Here to Buy book on Flipkart

45. (A) Hacking
Cybersecurity terminology identifies deliberate security breaches through specific terminology. Hacking refers to gaining unauthorized access or penetrating digital networks, servers, or personal computer systems to exploit technical vulnerabilities. Attackers perform hacking to retrieve restricted information, disrupt operations, or bypass authentication controls, establishing unauthorized administrative or user control over compromised digital infrastructure.

46. (C) Data theft
Confidential information assets require stringent protection against unauthorized access or exfiltration. When a malicious insider or external actor illegally accesses, copies, transfers, or extracts private corporate or personal data from systems without permission, the act constitutes data theft. This security violation directly undermines information confidentiality, intellectual property rights, and organizational data integrity.

47. (D) Phishing
Social engineering attacks often use technological deception to steal financial credentials. Phishing involves designing fraudulent communications or fake websites that closely imitate trusted banking portals or legitimate corporate entities. Tricked by these deceptive interfaces, victims unknowingly enter sensitive personal information, user passwords, or credit card numbers, which attackers capture to commit financial fraud.

48. (C) Identity theft
Fraudulent appropriation of personally identifiable information forms a distinct category of digital financial crime. When perpetrators unlawfully acquire and use another person's identifying details, such as government identification numbers, names, or banking credentials, to impersonate them for illicit financial gain or unauthorized transactions, the resulting criminal offense is legally classified as identity theft.

49. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Digital networks operate without physical geographical boundaries, allowing network packets to traverse international connections seamlessly. Cybercriminals leverage this borderless architecture to launch cyber attacks against targets in foreign countries from remote locations. Consequently, law enforcement agencies face severe jurisdictional obstacles when trying to investigate, track, extradite, or prosecute offenders operating outside national legal boundaries.

50. (D) Virus
Computer viruses represent a specific class of malicious software that cannot execute or spread independently. To function, a virus must attach its malicious code to an existing host file or executable program. When a user runs the infected host program, the embedded virus code executes, replicating itself by inserting copies into other clean system files.

51. (A) Worm
Computer worms differ fundamentally from standard file viruses in their operational autonomy and propagation mechanism. A worm is a standalone malicious program that actively scans network connections for system security vulnerabilities. Upon finding vulnerable target systems, it self-replicates and spreads across network connections automatically, requiring no host file attachment or human user intervention to propagate.

52. (C) Trojan Horse
Trojan horses exploit user trust by presenting themselves as useful, legitimate software programs. Unlike self-replicating malware, a Trojan horse relies on deception to trick users into executing it. Once installed, the program executes hidden malicious payloads, often creating unauthorized backdoors, modifying system configurations, or leaking sensitive computer data to remote cybercriminals without user authorization.

53. (A) Ransomware
Extortion-based cyberattacks employ specialized cryptographic malware to compromise system accessibility. Ransomware targets user files and system storage, employing strong encryption algorithms to render files unreadable. The attackers then display extortion messages demanding cryptocurrency payments in exchange for decryption keys, directly threatening permanent data destruction if ransom demands are not met by the victim.

Downloaded from www.pdf.tube

8. Which of the following correctly describes a hardware write blocker?
(A) It is a local system registry modification configured within the forensic analyst's operating system environment
(B) It is a specialized background software application running continuously on the suspect's target computer
(C) It is a physical device connected between the suspect storage drive and the forensic workstation
(D) It is an enterprise antivirus security program configured to actively block untrusted disk write operations

9. Match the cryptographic hash algorithms in List I with their corresponding output bit lengths in List II.
List I: Cryptographic Hash Algorithm
P. MD5
Q. SHA-1
R. SHA-256
S. CRC32
List II: Output Bit Length
1. 32-bit
2. 128-bit
3. 160-bit
4. 256-bit
(A) P-2, Q-3, R-4, S-1
(B) P-3, Q-2, R-1, S-4
(C) P-2, Q-4, R-3, S-1
(D) P-1, Q-2, R-3, S-4

10. Consider the following statements regarding the EnCase Evidence (E01) file format:
I. It is a bit-stream image format that includes embedded metadata about the case.
II. It cannot compress the acquired data.
III. It embeds cryptographic hash values to verify the integrity of the image.
Which of the above statements is/are correct?
(A) I and II
(B) I and III
(C) II and III
(D) I, II and III

11. In the FAT32 file system, what is the maximum theoretical size allowed for a single file?
(A) 2 GB
(B) 4 GB
(C) 16 GB
(D) 32 GB

12. Which file system relies on the Master File Table (MFT) to keep track of all files and directories?
(A) FAT32
(B) NTFS
(C) ext4
(D) APFS

13. When a file is deleted in a FAT file system (FAT16 or FAT32), what modification is made to the directory entry to mark the file as deleted?
(A) The first character of the directory entry filename is changed to 0xE5
(B) The entire file name entry in the directory table is overwritten with hexadecimal zeros
(C) The starting cluster location pointer in the file allocation table is immediately zeroed out
(D) The file extension attribute in the directory table is automatically renamed to .DEL

NODIA

14. How does the NTFS file system primarily handle the deletion of a file?
(A) It immediately overwrites all associated physical data clusters on the drive with binary zeros
(B) It automatically relocates the file metadata pointers directly into the $BadClus system file
(C) It marks the file's record in the Master File Table as inactive and available for new data
(D) It completely purges and deletes the corresponding record entry from the Master File Table

15. The exFAT file system was specifically designed by Microsoft to optimize performance for which type of storage?
(A) High-capacity sequential magnetic tape storage drives
(B) Standard optical disc media such as CD-ROM, DVD, and Blu-ray
(C) Large-scale Network Attached Storage (NAS) array systems
(D) Flash memory storage devices like USB drives and SD cards

16. Consider the following statements regarding file slack (slack space) in computer storage:
I. File slack is the total space consisting of RAM slack and drive slack.
II. RAM slack is the space from the end of the logical file to the end of the sector.
III. Drive slack is the space from the end of the RAM slack to the end of the cluster.

STUDYING FROM PDFs?

THINK AGAIN.

If you are studying only from PDFs,
you are wasting valuable time.

Research shows that learning from

PRINTED BOOKS has up to

4× HIGHER RETENTION

than studying from screens.

PRINT BOOK = BETTER MEMORY

PDF = LOWER RETENTION

Those who study from **PRINTED BOOKS**
move **AHEAD.**

Others are left **BEHIND**
in competition.

In competitive exams,
being average is not enough.

STAY ONE STEP AHEAD.

63. (D) Antivirus software
Malware detection relies on dedicated security software designed to monitor system activity. Antivirus software continuously scans memory, files, and incoming data streams against signature databases containing known malicious code patterns. Furthermore, advanced antivirus utilities utilize heuristic analysis to identify suspicious behavior, enabling the system to quarantine or remove malicious files before system infection occurs.

64. (C) Boot sector virus
Specific computer viruses target fundamental system boot mechanisms rather than standard operating files. A boot sector virus infects the master boot record or volume boot code located on storage drives. When the computer powers on, the virus code executes prior to loading the main operating system into memory, securing control over system hardware early in the boot sequence.

65. (B) Motherboard
Personal computer architecture centers around a main printed circuit board connecting fundamental components. The motherboard routes power and signals between the central processing unit, system RAM, expansion slots, and peripheral storage interfaces. Bus traces embedded within the board's layers facilitate high-speed data transmission between all internal components, forming the core physical foundation of computer system hardware.

66. (D) NAND flash memory
Mobile device storage architectures differ significantly from mechanical hard drives. Smartphones and tablet devices utilize solid-state NAND flash memory chips soldered directly onto internal system boards. NAND flash provides non-volatile, high-density storage that retains digital information without active power supplies, offering silent operation, high read speeds, and shock resistance required for portable mobile hardware.

67. (A) Actuator arm
Mechanical hard disk drives rely on electro-mechanical positioning mechanisms to access physical data tracks. The actuator arm sweeps read and write heads across the rapidly spinning magnetic platters. Controlled by a voice coil motor, the arm positions the heads precisely over targeted tracks to detect or modify magnetic alignments representing stored binary information.

68. (C) Blu-ray Disc
High-capacity optical media rely on short-wavelength optical lasers to focus data pits tightly on recording surfaces. Blu-ray media utilize a 405-nanometer blue-violet laser rather than the longer 650-nanometer red laser used in DVDs. This shorter laser wavelength allows higher data density, achieving a standard single-layer storage capacity of approximately 25 gigabytes per disc.

69. (A) Utility software
Computer system performance and hardware health are maintained through dedicated system software programs. Utility software provides specialized maintenance functions, such as disk defragmentation, virus removal, storage backup, and system diagnostics. Unlike general application programs that accomplish end-user tasks, utility programs focus on configuring, optimizing, analyzing, and maintaining underlying computer infrastructure resources.

70. (D) NTFS
Modern desktop operating systems require advanced file systems to organize, store, and protect digital data on storage volumes. NT File System is the standard primary file system used by modern Microsoft Windows platforms. NTFS offers key operational features including file-level encryption, granular access security permissions, journaling capabilities, and support for large volume sizes.

71. (B) I and III only
Network interfaces use MAC addresses and IP addresses for communication routing. A MAC address is a 48-bit physical identifier assigned during hardware manufacturing. IPv6 provides a 128-bit address structure designed to overcome IPv4 depletion. Conversely, IPv4 uses dotted-decimal representation, while IPv6 uses eight groups of hexadecimal characters, making the claim regarding IPv4 hexadecimal formatting incorrect.

72. (C) Eight colon-separated groups of hexadecimal digits
Internet Protocol version 6 addresses employ 128-bit binary length structures to accommodate global routing expansion. For human readability,

Click Here to Buy book on Amazon

www.nodia.in

NODIA

verification using multiple factors. Conversely, antivirus software relies heavily on signature databases and heuristic software routines rather than strictly hardware configurations to identify newly created malware strains.

82. (B) 1024 KB
Digital storage capacities operate on binary exponential measurement systems. Standard computer architecture defines byte multiples using powers of two, where 2 raised to the power of 10 equals 1024. Consequently, 1 Kilobyte equals 1024 bytes, and 1 Megabyte precisely equals 1024 Kilobytes, establishing the binary standard for memory allocation and physical drive measurement.

83. (B) 10
Converting binary positional notation into decimal format requires evaluating binary place values. The binary string 1010 represents place values of 8, 4, 2, and 1 from left to right. Summing the active position values yields eight plus zero plus two plus zero, which calculates to a total base-10 decimal value of 10.

84. (C) Base 16
The hexadecimal numeral system serves as a concise human-readable shorthand for binary data representations. Base-16 positional notation uses sixteen distinct symbols: numbers 0 through 9 represent values zero to nine, while letters A through F represent values ten to fifteen. This base-16 radix maps directly to four-bit binary nibbles, simplifying memory addresses and MAC address representations.

85. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Phishing attacks rely fundamentally on human psychological exploitation rather than technical system exploits. By creating convincing fraudulent communications, attackers exploit trust, urgency, or authority to manipulate victims into revealing sensitive authentication details voluntarily. Because the primary attack vector targets human trust rather than technical software bugs, phishing is categorized as a prominent form of social engineering.

86. (D) Data encryption
Protecting confidential information on seized digital hardware requires robust cryptographic safeguards. Data encryption uses mathematical algorithms to convert readable plaintext into unreadable ciphertext using cryptographic keys. If physical storage media or digital devices are lost, stolen, or intercepted, encryption ensures unauthorized parties cannot read or extract sensitive stored files without the corresponding decryption key.

87. (B) Botnet
Modern cyber threats leverage network collections of compromised devices to execute automated attacks. A botnet consists of multiple infected personal computers or network devices controlled remotely by a central attacker, known as a botmaster. Command and control servers manipulate these compromised systems to send spam, conduct credential stuffing, or launch coordinated distributed denial of service attacks.

88. (A) P-2, Q-1, R-4, S-3
Cybercrimes are categorized based on targets and operational impacts. Cyber stalking targets individuals through persistent harassment, representing a crime against person. Data theft compromises confidential electronic records, constituting a property crime. Distributed denial of service attacks flood server bandwidth, targeting system availability. Credit card skimming targets financial data and credentials, representing financial cybercrime.

89. (D) Mesh topology
High-availability network architectures require maximum redudancy to eliminate single points of failure. In a full mesh network topology, every single computing node is connected directly via dedicated point-to-point links to every other node in the network. This comprehensive redundancy guarantees uninterrupted packet delivery, as traffic automatically reroutes around any individual cable or node failure across the network.

90. (A) SSH
Administering remote computers securely across untrusted networks requires encrypted communication channels. Secure Shell provides an encrypted network protocol designed for secure command-line access, remote execution, and data tunneling. Unlike unencrypted legacy protocols like Telnet or HTTP, SSH encrypts all transmitted traffic, including user passwords and session data, preventing eavesdropping and packet interception on untrusted networks.

Downloaded from www.pdf.tube

54. (D) Keylogger
Monitoring software can be used maliciously to harvest private authentication credentials silently. Keyloggers operate as background surveillance software or hardware attachments that systematically record every individual keystroke typed on a keyboard. Attackers extract these logged keystroke logs to recover user passwords, private messages, account numbers, and sensitive personal information covertly without user detection.

55. (B) Denial of Service (DoS) attack
Disrupting online services often involves overwhelming network interfaces with excessive traffic volume. A Denial of Service attack floods targeted servers, services, or network infrastructures with an overwhelming volume of automated traffic requests. This artificial saturation exhausts system memory, processor capacity, or bandwidth, preventing legitimate network users from accessing target services effectively.

56. (C) A DDoS attack uses multiple systems (a botnet) simultaneously, whereas a DoS attack uses a single source.
Resource exhaustion attacks differ based on the number of attacking origins used. A standard Denial of Service attack originates from a single attacking computer system or connection. In contrast, a Distributed Denial of Service attack utilizes multiple compromised host systems, known as a botnet, to launch coordinated traffic floods from diverse geographical network locations simultaneously.

57. (D) Social Engineering
Human psychology represents a major focal point in cyber security threat vectors. Social engineering bypasses technical security barriers by psychologically manipulating individuals into revealing confidential credentials or granting unauthorized system access. Attackers leverage trust, urgency, fear, or authority to deceive personnel, exploiting human vulnerabilities rather than flaws in technical software code or hardware systems.

58. (A) P-2, Q-3, R-4, S-1
Different categories of malware exhibit distinct functional characteristics. Ransomware encrypts user data to demand monetary ransom payments. Spyware silently monitors system activities, harvesting keystrokes and sensitive information. Trojan horses masquerade as benign programs to trick users into execution. Worms operate as autonomous, self-replicating programs that propagate across computer network channels without host file attachments.

NODIA

59. (B) Cyber terrorism
Severe digital attacks threatening national security fall under specific legislative definitions. Under Section 66F of the Information Technology Act, acts committed to threaten the unity, integrity, security, or sovereignty of the nation, or to instill terror through unauthorized computer access, service denial, or network disruption, are formally defined and penalized as cyber terrorism.

60. (B) The POCSO Act
Protecting minors from digital exploitation requires combined legal frameworks operating alongside IT legislation. The Protection of Children from Sexual Offences (POCSO) Act works together with the Information Technology Act to prosecute offences involving child sexual abuse material. This legal framework penalizes the creation, possession, transmission, or dissemination of explicit digital media involving minors across online networks.

61. (A) I and II only
Cybercrimes against persons target individual human beings directly. Cyber stalking involves persistent online monitoring and harassment of individuals without consent. Online defamation publishes false statements damaging personal reputation across digital platforms. In contrast, data theft targets electronic files, proprietary databases, and digital infrastructure, classifying it primarily as a crime against property rather than a direct personal offense.

62. (C) To filter network traffic based on security rules.
Network defense systems establish protective boundaries between internal networks and external traffic. Firewalls inspect incoming and outgoing network packets against defined security rules and access control lists. By blocking unauthorized connection attempts while allowing legitimate data flow, firewalls act as primary perimeter defenses, preventing network intrusions and unauthorized remote access to computing systems.

CHAPTER 32

Digital Evidence, File Systems and Data Recovery

1. In the context of computer forensics, which of the following best defines digital evidence?
(A) Any physical hardware seized from a crime scene
(B) Information and data of investigative value that is stored on or transmitted by an electronic device
(C) Only the printed documents recovered from a suspect's computer
(D) Only the user-generated text files found on a hard drive

2. According to standard police digital forensic guidelines, such as the ACPO principles, what is the core rule regarding the handling of original digital evidence?
(A) Law enforcement should modify data to make it readable in court
(B) Only automated commercial tools should be used for analysis
(C) Digital evidence must always be analysed on the live original system
(D) No action taken by law enforcement agencies should change data held on a computer or storage media

3. Select the correct order of volatility for digital evidence, from the most volatile to the least volatile, according to standard digital forensic principles.
(A) System RAM → CPU Registers → Network State → Hard Disk
(B) CPU Registers → System RAM → Network State → Hard Disk
(C) Network State → System RAM → CPU Registers → Hard Disk
(D) System RAM → Network State → CPU Registers → Hard Disk

4. Which of the following is considered volatile data in a powered-on computer system?
(A) Files stored in the Document folder
(B) Operating system registry files on the disk
(C) Active network connections and ARP cache
(D) Master Boot Record (MBR)

5. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Digital evidence is highly fragile and can be easily altered or destroyed during improper collection.
Reason (R): Merely turning on a computer system alters files, timestamps, and memory caches.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

6. What is the primary purpose of computing a cryptographic hash (such as MD5 or SHA-256) in digital forensics?
(A) To encrypt the digital evidence so it cannot be read by unauthorized users
(B) To compress the forensic image to save disk space
(C) To automatically recover deleted files from unallocated space
(D) To verify the integrity of the data and prove it has not been altered

7. What is a "write blocker" in digital forensics?
(A) A specialized software utility designed to permanently erase and sanitize files from a hard drive
(B) A hardware or software mechanism that blocks write commands from modifying a target storage device
(C) A cryptographic security algorithm used to lock and restrict access to confidential evidence files
(D) A low-level formatting utility used to wipe and prepare suspect drives prior to forensic acquisition

Click Here to Buy book on Flipkart

these 128 bits are divided into eight separate 16-bit blocks. Each block is expressed as four hexadecimal digits, and the eight groups are separated by colons, establishing the standardized text formatting convention for IPv6 addresses.

73. (D) Unindexed web content like private banking portals, webmail, and databases.
The web contains extensive content inaccessible to search engine crawlers. The deep web refers to web pages, databases, and online services that are not indexed by standard web crawlers. This includes password-protected personal accounts, private webmail, corporate databases, medical records, and subscription services, forming the overwhelming majority of online digital information systems.

74. (B) Data Link Layer (Layer 2)
Multi-port network switches manage local data traffic at the physical link level. Operating at Layer 2, the Data Link Layer, switches examine incoming Ethernet frame headers to extract hardware MAC addresses. By mapping MAC addresses to specific physical network ports, switches forward incoming frames directly to target endpoints within local area network segments.

75. (B) DNS resolves domain to IP, TCP connection established, HTTP Request sent, Server sends HTTP Response
Retrieving online web resources requires a structured network resolution and connection process. First, the browser queries domain name servers to resolve the domain name into a target IP address. Second, a transport-layer TCP connection establishes network communication with the remote server. Third, an HTTP request is transmitted, prompting the target web server to process and return the requested response data.

76. (B) The manufacturer of the network interface card.
Hardware MAC addresses consist of 48 binary bits structured into specific functional blocks. The first 24 bits, or three bytes, are designated as the Organizationally Unique Identifier. Assigned by the IEEE registration authority, this prefix identifies the specific hardware manufacturer that produced the network interface controller, providing vital hardware origin intelligence during forensic investigations.

77. (A) Vishing
Fraudulent credential harvesting adapts across various communication vectors. Vishing, or voice phishing, involves voice-based social engineering conducted through landline or cellular phone networks. Cybercriminals use automated voice systems or direct phone calls, frequently spoofing official caller IDs, to trick victims into revealing sensitive personal credentials, financial passwords, or private bank account access details.

78. (C) Spear phishing
Social engineering tactics vary from broad electronic mail distributions to highly customized attacks. Spear phishing involves tailored communications targeting specific individuals, organizations, or enterprise executives. Attackers gather background intelligence on target individuals to craft convincing, personalized email messages, drastically increasing the likelihood that targets will trust the email and reveal confidential network credentials.

79. (D) Confidentiality, Integrity, Availability
Information security frameworks revolve around three foundational security pillars known as the CIA Triad. Confidentiality ensures sensitive data remains accessible only to authorized users. Integrity guarantees information remains accurate, unaltered, and protected against unauthorized modifications. Availability ensures computing systems, communication channels, and data assets remain reliably accessible to legitimate users whenever required.

NODIA

80. (A) 3, 2, 4, 1
System startup follows a strict hardware and software sequence. Powering on delivers electricity to the CPU, executing basic input/output firmware code. The system then runs the Power-On Self-Test to verify hardware component readiness. Once hardware passes diagnostic checks, control shifts to the bootloader, which locates and loads the primary operating system kernel into system memory.

81. (B) I, III and IV
Robust cybersecurity involves multi-layered defense solutions. Network firewalls filter traffic based on security policies, data encryption safeguards confidentiality by converting plaintext into unreadable ciphertext, and multi-factor authentication enhances identity

IV. Slack space always contains only zero bytes and never residual data.
Which of the above statements is/are correct?
(A) I, II and III are correct
(B) II, III and IV are correct
(C) I and IV are correct
(D) All statements are correct

17. Which of the following file systems is predominantly used as the standard default in modern Linux distributions?
(A) NTFS
(B) ext4
(C) HFSzzz+
(D) FAT32

18. What does ReFS stand for in the context of modern Windows file systems?
(A) Reliable File Structure
(B) Recoverable File Sector
(C) Redundant Format System
(D) Resilient File System

19. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Recovering deleted files from modern Solid State Drives (SSDs) is often significantly more difficult than from traditional Hard Disk Drives (HDDs).
Reason (R): Modern SSDs utilize the TRIM command, which actively wipes unallocated data blocks during background garbage collection to optimize performance.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

20. The Master Boot Record (MBR) partitioning scheme has a fundamental limitation regarding the maximum addressable disk size. What is this approximate limit?
(A) 500 GB
(B) 1 TB
(C) 2 TB
(D) 8 TB

21. Which partitioning scheme was developed to overcome the limitations of MBR, supporting massive disk sizes and allowing up to 128 partitions in a Windows environment?
(A) GPT (GUID Partition Table)
(B) APM (Apple Partition Map)
(C) VBR (Volume Boot Record)
(D) LVM (Logical Volume Manager)

22. Which operating system utilizes the APFS (Apple File System) as its default file system for solid-state drives?
(A) Windows 10
(B) Ubuntu Linux
(C) Android
(D) macOS

23. Consider the following components found in a standard Master Boot Record (MBR) architecture:
I. Boot execution code
II. Partition table
III. Master File Table ($MFT)
Which of the above components is/are physically located within the first 512-byte MBR sector of a disk?
(A) I and II
(B) II and III
(C) I only
(D) I, II and III

NODIA

24. What technique involves extracting files directly from the raw data of a drive based on specific header and footer signatures, without relying on file system metadata?
(A) Hashing
(B) Steganography
(C) File Carving
(D) Live Acquisition

25. In digital forensics, what do the MAC timestamps associated with a file's metadata stand for?
(A) Mandatory, Allocated, Calculated
(B) Master, Alternate, Current
(C) Machine, Application, Code
(D) Modified, Accessed, Created

26. Match the file types in List I with their standard hexadecimal file header signatures in List II.
List I: File Type
P. JPEG image
Q. PDF document
R. ZIP archive
S. Windows Executable (EXE)
List II: Hexadecimal Signature
1. 25 50 44 46
2. 50 4B 03 04
3. 4D 5A

4. FF D8

(A) P-4, Q-1, R-2, S-3
(B) P-1, Q-4, R-3, S-2
(C) P-4, Q-2, R-1, S-3
(D) P-2, Q-1, R-4, S-3

27. What is the definition of "unallocated space" on a storage drive?
(A) Storage areas on the disk surface that are physically damaged and permanently unusable
(B) Clusters not currently assigned to an active file by the file system
(C) The unused portion of a cluster that remains unfilled by the file assigned to that cluster
(D) Dedicated partition space reserved strictly for exclusive use by the operating system kernel

28. Arrange the following logical storage structures in increasing order of their typical physical/ logical storage size, from smallest to largest:
I. Sector
II. Partition
III. Cluster
IV. Track
(A) I, III, IV, II
(B) I, IV, III, II
(C) III, I, IV, II
(D) IV, I, III, II

29. When writing a file to disk, the operating system pads the unused portion of the final sector with data to fill the 512-byte block. This specific padded space is known as:
(A) RAM slack
(B) Drive slack
(C) Unallocated space
(D) Volume boot sector

30. Which area of storage is most likely to contain residual data from previously deleted files, making it highly valuable in forensic data recovery?
(A) The physical sector designated for the Master Boot Record
(B) Storage areas comprising active allocated file system clusters
(C) Slack space and unallocated disk space
(D) Partition areas holding the main Volume Boot Record code

31. Which of the following is considered an anti-forensics technique?
(A) Creating an exact bit-stream forensic disk image of a target hard drive for offline analysis
(B) Calculating cryptographic MD5 checksum hashes for all seized digital evidence files
(C) Extracting embedded EXIF metadata properties from recovered JPEG digital image files
(D) Overwriting unallocated disk clusters using specialized secure data wiping tools

32. The DoD 5220.22-M standard is commonly referenced in digital forensics. What does this standard relate to?
(A) File carving signatures
(B) Cryptographic hashing functions
(C) Secure data wiping algorithms
(D) Physical security of forensic laboratories

33. The practice of hiding a secret message or file within an ordinary, non-suspicious file (such as hiding text within an image file) is known as:
(A) Cryptographic encryption
(B) Steganography
(C) Hashing algorithms
(D) File carving methods

34. In steganography, what does the technique known as LSB manipulation involve?
(A) Systematically modifying the underlying Logical System Bytes within an operating system kernel
(B) Locking the hardware-level Secure Block controller located on a target hard disk drive
(C) Throttling down total network bandwidth consumption to conceal suspicious data exfiltration
(D) Modifying the least significant bit values of pixel data within a digital image file

35. What is a brute-force attack in the context of password cracking?
(A) Trying every possible character combination systematically until matching the password
(B) Automated matching of target password hashes against a large predefined list of dictionary words
(C) Exploiting structural cryptographic weaknesses within the hashing algorithm to bypass authentication
(D) Intercepting and capturing user authentication credentials directly using specialized keylogger malware

Downloaded from www.pdf.tube

36. Which password cracking technique uses precomputed tables of hash values to quickly reverse cryptographic hashes?
(A) Dictionary attack
(B) Phishing attack
(C) Rainbow table attack
(D) Man-in-the-middle attack

37. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Steganography is distinct from cryptography in its primary objective.
Reason (R): Cryptography scrambles a message to make it unreadable, whereas steganography hides the very existence of the message.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

38. Which commercial company is the developer of the widely used digital forensics software "EnCase"?
(A) AccessData Corporation
(B) Cellebrite Mobile Synchronization
(C) Magnet Forensics Incorporated
(D) Guidance Software (now OpenText)

39. "Autopsy" is a popular open-source digital forensics platform. It serves as a graphical user interface for which underlying suite of command-line tools?
(A) Forensic Toolkit (FTK)
(B) The Sleuth Kit (TSK)
(C) Volatility Framework
(D) Wireshark

40. Match the digital forensic tools in List I with their primary function in List II.
List I: Digital Forensic Tool
P. EnCase
Q. Autopsy
R. John the Ripper
S. OpenStego
List II: Primary Function
1. Password Cracking Tool
2. Steganography Tool
3. Commercial Forensic Suite
4. Open-Source Forensic Interface
(A) P-3, Q-4, R-1, S-2
(B) P-4, Q-3, R-2, S-1
(C) P-3, Q-1, R-4, S-2
(D) P-1, Q-4, R-2, S-3

41. Under the Bharatiya Sakshya Adhiniyam, 2023, which specific section dictates the requirement of a certificate for the admissibility of electronic or digital records in Indian courts?
(A) Section 59
(B) Section 61
(C) Section 63
(D) Section 65

NODIA

42. Consider the following statements regarding the "Chain of Custody" in digital forensics:
I. It chronologically tracks the movement and handling of the evidence.
II. It helps prevent allegations of evidence tampering in court.
III. It must document the name of every person who took possession of the evidence.
IV. It can be discarded once the forensic laboratory analysis report is finalized.
Which of the above statements is/are correct?
(A) I, II and IV are correct
(B) I, II and III are correct
(C) II, III and IV are correct
(D) All statements are correct

43. When drafting a digital forensic report, which of the following characteristics is essential for the scientific validity of the findings?
(A) The investigative findings must be based on subjective interpretation and analyst intuition
(B) The methodology must be repeatable and reproducible by independent examiners
(C) The finalized report must intentionally omit detailed tool logs to protect proprietary trade secrets
(D) The overall analytical conclusions must unconditionally guarantee the criminal guilt of the suspect

44. In forensic data acquisition, what is the primary difference between a physical bit-stream extraction and a logical extraction?
(A) Physical extraction relies exclusively on software utilities to capture data, whereas logical extraction strictly requires dedicated hardware write blockers
(B) Physical extraction copies the entire drive bit-by-bit including unallocated space, while logical extraction copies only active files
(C) Physical extraction runs much faster by

automatically compressing drive content, whereas logical extraction involves lengthy manual data parsing
(D) Logical extraction is designed specifically to recover deleted raw files, whereas physical extraction can only access currently existing active files

45. In a Windows system, which system file is created when the computer goes into hibernation and can contain a complete snapshot of system memory (RAM)?
(A) hiberfil.sys
(B) pagefile.sys
(C) swapfile.sys
(D) bootmgr.sys

46. Which of the following Windows system files acts as virtual memory and is highly relevant to digital forensics because it may contain fragments of passwords, documents, or active network connections swapped out from RAM?
(A) config.sys
(B) ntdetect.com
(C) pagefile.sys
(D) ntldr

47. To prevent external radio frequencies from altering digital evidence on a seized mobile phone, a first responder should place the device in a:
(A) Plastic evidence bag
(B) Paper envelope
(C) Anti-static wrist strap
(D) Faraday bag

48. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): "Pulling the plug" (immediately disconnecting power) is no longer the universally recommended first response for all seized computers.
Reason (R): Pulling the plug on a live system will cause the permanent loss of volatile memory (RAM) and can lock data on systems utilizing full disk encryption (like BitLocker).
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

49. In the NTFS file system, which system file is responsible for maintaining a record of all file metadata and attributes?
(A) $Bitmap
(B) $MFT
(C) $LogFile
(D) $Boot

50. The NTFS file system is classified as a "journaling" file system. What is the primary forensic significance of the journal ($LogFile)?
(A) It securely logs user passwords and account credentials for administrative auditing across the machine
(B) It systematically overwrites and sanitizes unallocated disk space whenever the operating system is idle
(C) It automatically applies volume-level bitlocker encryption across all storage partitions on the drive
(D) It logs file system transactions before completion, helping reveal deleted or modified files

51. The "Raw" forensic image format (often given the extension .dd or .img) is best described as:
(A) A bit-for-bit copy of raw data without compression or case metadata
(B) A proprietary compressed image structure specifically designed to reduce forensic storage requirements
(C) An encrypted container format that embeds examiner logs, baseline hashes, and official case metadata
(D) A specialized text-based export archive that records directory structures and file allocation tables

52. The primary state-level nodal laboratory handling comprehensive cyber and digital forensic examinations under the Directorate of Forensic Science in Uttar Pradesh is located at:
(A) Regional FSL Agra
(B) Regional FSL Varanasi
(C) State FSL Lucknow
(D) CFSL Hyderabad

53. Match the file systems in List I with their standard operating system in List II.
List I: File System
P. NTFS
Q. ext4
R. APFS
S. FAT32

Click Here to Buy book on Amazon

List II: Operating System
1. Universal / Legacy Media
2. macOS
3. Linux
4. Windows

(A) P-4, Q-3, R-2, S-1
(B) P-3, Q-4, R-1, S-2
(C) P-4, Q-2, R-3, S-1
(D) P-1, Q-3, R-2, S-4

54. In standard traditional hard disk architecture, what is the default size of a single physical sector?
(A) 256 bytes
(B) 512 bytes
(C) 1024 bytes (1 KB)
(D) 4096 bytes (4 KB)

55. Consider the following functions of a forensic write blocker:
I. It prevents any write operations from modifying the source evidence drive.
II. It allows read operations to pass freely from the source drive to the forensic workstation.
III. It automatically changes the metadata of the source drive to log the acquisition time.
Which of the above statements is/are correct?
(A) I and II
(B) I and III
(C) II and III
(D) I, II and III

56. When a forensic analyst completes the imaging of a hard drive, they compute the hash of the original drive and the hash of the image file. If the two hash values match perfectly, it proves that:
(A) The acquired image file is completely free of any malicious software, viruses, or hidden trojans
(B) The source storage drive contains definitive evidence related to the cybercrime under investigation
(C) The image file is an exact, unaltered bit-stream copy of the source drive
(D) The disk encryption mechanism protecting the target storage volume has been successfully decrypted

57. Select the correct order of the standard phases in the digital forensic process.
(A) Analysis → Identification → Collection → Acquisition → Reporting
(B) Identification → Collection → Acquisition → Analysis → Reporting
(C) Collection → Analysis → Identification → Reporting → Acquisition
(D) Identification → Analysis → Acquisition → Collection → Reporting

58. If a first responder arrives at a scene and finds a computer powered on and connected to a network, what is the best practice if live memory acquisition is not immediately possible?
(A) Isolate the system from the network to prevent remote wiping commands
(B) Immediately disconnect the physical power supply cable directly from the wall socket or device power port
(C) Initiate a standard graceful operating system shutdown sequence using the standard start menu options
(D) Perform an immediate hardware reboot of the target machine directly into safe mode diagnostic environment

NODIA

59. In the context of cryptographic hashing, what is a "collision"?
(A) When a generated hash value alters unexpectedly after relocating a file to a new directory path
(B) When two distinct files yield the same output hash value
(C) When an unexpected physical hardware failure or drive crash occurs while generating file hashes
(D) When a specialized forensic tool encounters an unreadable bad disk sector during verification imaging

60. The tool "Volatility" is fundamentally utilized in digital forensics for which specific purpose?
(A) Password cracking using rainbow tables
(B) Memory (RAM) forensics and analysis
(C) Network packet sniffing
(D) Recovering data from scratched CDs

61. If an investigator takes a photograph in JPEG format and only renames the file from "image1.jpg" to "secret.jpg" without opening or editing the image content, what will happen to its MD5 hash value?
(A) The hash value will remain exactly the same
(B) The hash value will change completely
(C) The hash value will become a mix of MD5 and SHA-1
(D) The file will no longer be able to generate a hash

ANSWERS

1. (B) Information and data of investigative value that is stored on or transmitted by an electronic device
Digital evidence encompasses any binary data or information that possesses probative or investigative value, stored within or transmitted across electronic devices. It plays a critical role in establishing facts during legal proceedings or forensic examinations. The integrity and authenticity of such electronic records must be meticulously maintained from initial seizure through judicial presentation.

2. (D) No action taken by law enforcement agencies should change data held on a computer or storage media
Standard digital forensic guidelines mandate that law enforcement officers or investigators must not perform actions that alter data stored on computers or electronic media. Preserving original evidence in its pristine state ensures admissibility in judicial proceedings. Any necessary access should strictly involve trained personnel who can justify their methodology and maintain complete operational records.

3. (B) CPU Registers → System RAM → Network State → Hard Disk
Order of volatility dictates the sequence in which digital evidence must be preserved to prevent permanent loss. High-speed processor registers and caches lose data almost instantaneously upon state change. System main memory persists only while powered, followed by temporary network state routing tables and active connection sockets, whereas non-volatile persistent storage magnetic or solid-state disks retain data indefinitely.

4. (C) Active network connections and ARP cache
Volatile data exists within temporary memory structures or network interfaces that are cleared immediately when system power is disconnected or interrupted. Active network connection states, socket bindings, open ports, and address resolution protocol caches reside in temporary kernel tables and main random-access memory, requiring dynamic live acquisition before power termination permanently erases these volatile forensic artifacts.

5. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Digital evidence is inherently fragile because routine operating system operations continuously write background data to storage media. Simply booting or interacting with a computer alters system logs, file access timestamps, temporary registry caches, and volatile memory allocations. Consequently, unmitigated interaction distorts original evidence states, directly illustrating why digital records require strict preservation protocols during seizure.

6. (D) To verify the integrity of the data and prove it has not been altered
Cryptographic hash algorithms produce fixed-length mathematical checksums unique to specific input data streams. Generating hash values before and after forensic processing allows examiners to demonstrate that digital evidence remained unmodified throughout acquisition, storage, and analytical stages. Any single bit modification fundamentally changes the calculated digest, providing verifiable mathematical proof of data integrity for judicial verification.

7. (B) A hardware or software mechanism that blocks write commands from modifying a target storage device
A write blocker is an essential forensic tool implemented through dedicated hardware devices or specialized system software drivers. Its primary role is intercepting write commands issued by an operating system while permitting read requests to pass through unimpeded. This safeguards target storage drives against accidental metadata updates, timestamp alterations, or data corruption during acquisition procedures.

8. (C) It is a physical device connected between the suspect storage drive and the forensic workstation
Hardware write blockers are physical electronic units connected in-line between an evidence storage device and an analytical workstation. They physically isolate signal lines responsible for write operations, ensuring operating system commands cannot modify target media contents.

Downloaded from www.pdf.tube

(A) It requires substantially higher computational processing time during acquisition phases
(B) It misses deleted files, slack space, and unallocated disk areas
(C) It necessitates opening drive enclosures and physically disassembling storage platters
(D) It applies aggressive automated compression that frequently leads to evidence corruption

72. Which command-line tool, part of The Sleuth Kit (TSK), is used to list file and directory names in a disk image and can display deleted files?
(A) mmls
(B) fsstat
(C) fls
(D) dd

73. When a user performs a "Quick Format" on a hard drive in Windows, what happens to the data?
(A) Every physical sector across the entire storage volume is permanently overwritten with hexadecimal zeros
(B) The internal magnetic platters of the hard disk drive are subjected to high-coercivity degaussing
(C) Damaged disk sectors are automatically remapped and physically repaired at the firmware level
(D) It resets file system structures while leaving file data in unallocated space

74. If a hard drive has suffered severe physical damage (e.g., a shattered platter or stuck read/write head), where must the drive be opened to prevent contamination during physical data recovery?
(A) In a Class 100 cleanroom
(B) In a standard forensic imaging lab
(C) In a Faraday cage
(D) In a vacuum chamber

75. What type of encryption algorithm uses the exact same key for both the encryption of plaintext and the decryption of ciphertext?
(A) Asymmetric encryption
(B) Symmetric encryption
(C) Public key infrastructure
(D) Hash encryption

76. During a digital forensic investigation, the examiner checks the computer's BIOS/UEFI time. Why is this step critical?
(A) To verify hardware CPU clock speeds and detect potential processor overclocking
(B) To calculate clock offset for accurate timestamp correlation
(C) To perform diagnostic hardware testing to identify physical drive head damage
(D) To bypass master firmware passwords restricting access to storage devices

77. Which of the following is considered a primary principle of digital evidence handling corresponding to Locard's Exchange Principle in physical forensics?
(A) Every digital interaction leaves traceable evidence like logs and IP addresses
(B) Stored digital file contents naturally degrade over time when exposed to cosmic background radiation
(C) Cryptographic hash signatures automatically change whenever a file is moved or renamed in the OS
(D) Modern solid-state flash drives are permanently soldered and cannot be physically extracted safely

78. In digital forensics, EXIF data is a form of metadata most commonly associated with which type of files?
(A) Executable binary application files (.exe / .dll)
(B) Windows system registry hive database files (.dat)
(C) Digital photograph image files (.jpg / .tiff)
(D) Compressed system file archives (.zip / .tar)

79. What specific information can frequently be recovered from the EXIF metadata of a photograph taken by a modern smartphone?
(A) The lock screen PIN code or passcode of the smartphone device
(B) Confidential user banking credentials and online account records
(C) The saved Wi-Fi authentication passwords of nearby wireless networks
(D) Embedded GPS coordinates specifying location

80. The process of searching for and analyzing hidden messages or steganography content in digital media is known as:
(A) Cryptanalysis
(B) File carving
(C) Steganalysis
(D) Decompilation

NODIA

62. The first sector of a volume or partition on a storage device, which contains code to bootstrap the operating system and the BIOS Parameter Block (BPB), is called the:
(A) Master Boot Record (MBR)
(B) Master File Table (MFT)
(C) Volume Boot Record (VBR)
(D) GUID Partition Table (GPT)

63. A cluster size is 4096 bytes. A file sized exactly 1000 bytes is saved to the disk. How much slack space is created in that cluster?
(A) 0 bytes
(B) 1000 bytes
(C) 3096 bytes
(D) 4096 bytes

64. Consider the following statements about File Carving:
I. It recovers files by identifying characteristic file headers and footers.
II. It does not rely on the file system's allocation tables or metadata.
III. It struggles to successfully recover highly fragmented files.
IV. It can easily bypass full disk encryption without the key.
Which of the above statements is/are correct?
(A) I, II and III are correct
(B) II, III and IV are correct
(C) I and IV are correct
(D) All statements are correct

65. In the NTFS file system, what is the specific role of the $Bitmap system file?
(A) It caches system desktop wallpapers and user profile graphic assets
(B) It tracks cluster allocation status showing free and used clusters
(C) It maintains a hardware diagnostic error log for bad sectors on the disk
(D) It manages transparent file encryption keys for personal user documents

66. Which data structure is used by Linux file systems (such as ext3/ext4) to store metadata about a file, such as size, permissions, and location of data blocks, but does not store the file name?
(A) Master File Table
(B) Catalog File
(C) Directory Entry
(D) Inode

67. Arrange the following sources of digital evidence in the correct order of data volatility, from the most volatile to the least volatile:
I. System RAM
II. CPU Registers and Cache
III. Network Routing Table
IV. Hard Drive (Disk Storage)
(A) I, II, III, IV
(B) II, I, III, IV
(C) II, III, I, IV
(D) III, II, I, IV

68. Consider the following statements about data wiping and anti-forensics:
I. Wiping tools overwrite data with zeros or complex random patterns.
II. A single pass of overwriting with zeros is generally sufficient to prevent recovery by standard software forensic tools.
III. Secure wiping merely removes the file's directory entry, leaving the data intact in unallocated space.
Which of the above statements is/are correct?
(A) I and II
(B) I and III
(C) II and III
(D) I, II and III

69. In password security, what is the forensic significance of "salting" a password before hashing it?
(A) It appends random data to passwords, neutralizing precomputed rainbow table attacks
(B) It intentionally truncates long passphrases to accelerate hash processing and storage
(C) It applies lossy compression algorithms to minimize the stored digital hash string size
(D) It activates full volume hardware encryption across all non-volatile storage partitions

70. Alternate Data Streams (ADS) are a feature of which file system that allows data to be hidden behind an existing file without changing the original file's size or functionality?
(A) FAT32
(B) APFS
(C) ext4
(D) NTFS

71. What is the fundamental disadvantage of performing only a "logical" copy of a suspect's hard drive instead of a bit-stream physical image?

Click Here to Buy book on Flipkart

(C) Open, unrestricted high-speed internet connectivity across all operational forensic workstations

(D) Laboratory exterior windows must remain fully transparent to enable continuous public observation

www.nodia.in

Downloaded from www.pdf.tube

built-in integrity streams using cryptographic checksums to detect file corruption, automatic background integrity verification, and seamless metadata resiliency, rendering it highly effective for enterprise server storage configurations.

19. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Solid State Drive data recovery is challenging compared to traditional hard disks due to background garbage collection operations. Modern drive firmware utilizes the TRIM command to inform solid-state controllers about deleted blocks. The controller actively overwrites and zeros these unallocated flash memory blocks during idle cycles, causing rapid destruction of residual forensic data.

20. (C) 2 TB
The Master Boot Record partitioning structure relies on 32-bit logical block addressing within its partition table fields. Assuming a standard sector size of 512 bytes, 32 bits can address a maximum of 2^{32} distinct sectors. This architectural limitation bounds the maximum addressable capacity of an MBR partitioned disk drive to approximately two terabytes.

21. (A) GPT (GUID Partition Table)
The GUID Partition Table architecture was developed to replace legacy Master Boot Record limits. Standard GPT uses 64-bit logical block addressing, enabling support for maximum storage volume sizes reaching zettabytes. In Microsoft Windows operating systems, GPT supports up to 128 primary partitions while incorporating redundant backup headers for structural fault recovery.

22. (D) macOS
Apple File System is the default proprietary file system developed by Apple for macOS, iOS, iPadOS, and watchOS operating environments. Designed specifically for solid-state drives and flash storage devices, it offers strong encryption features, space sharing, fast directory cloning, snapshot functionality, and improved file system fundamentals compared to its HFSzzz+ predecessor.

23. (A) I and II
The physical Master Boot Record occupies the first 512-byte sector of a disk partitioned under MBR. This single sector contains executable bootloader code responsible for locating the active boot partition, followed by a 64-byte primary partition table detailing partition boundaries, and a final boot signature word. Master File Tables reside within NTFS partitions.

NODIA

24. (C) File Carving
File carving is an advanced forensic data recovery technique that identifies and extracts file structures directly from raw disk sectors. It bypasses corrupt or missing file allocation metadata by scanning binary storage streams for specific magic number byte sequences representing file headers and footers, enabling content reconstruction within unallocated drive space.

25. (D) Modified, Accessed, Created
In file system metadata analysis, the acronym MAC stands for Modified, Accessed, and Created timestamps. These temporal markers record when a specific file was last modified in content, last accessed by an application or user, and originally created within the file system, enabling forensic examiners to construct precise chronological event timelines.

26. (A) P-4, Q-1, R-2, S-3
File headers start with unique hexadecimal byte sequences called magic numbers. JPEG image files begin with FF D8, whereas PDF documents initiate with 25 50 44 46 (%PDF). ZIP archive structures start with the bytes 50 4B 03 04 (PK..), and Windows executable EXE binaries begin with 4D 5A (MZ), matching option requirements.

27. (B) Clusters not currently assigned to an active file by the file system
Unallocated space refers to storage blocks or clusters on a drive that are not assigned to active files by the file system. Although invisible to standard operating system file browsers, unallocated space frequently retains residual data from previously stored, moved, or deleted files, making it a critical focus for forensic recovery.

28. (A) I, III, IV, II
Storage structures vary in capacity hierarchy from smallest to largest. A physical sector is the smallest unit, typically measuring 512 bytes or 4096 bytes. Multiple sectors group together into a cluster. Disk tracks consist of circular rings containing multiple sectors and clusters, while

Physical write blockers operate independently of host software drivers, providing robust write protection verified by dedicated onboard microcontrollers.

9. (A) P-2, Q-3, R-4, S-1
Cryptographic algorithms produce output digests with precise standard bit lengths. MD5 generates a 128-bit hash value, whereas SHA-1 outputs a 160-bit digest. SHA-256 produces a 256-bit cryptographic digest offering higher collision resistance. CRC32 generates a simple 32-bit error-checking checksum, forming the correct pairing across these distinct data integrity verification functions.

10. (B) I and III
The Expert Witness Compression file format, commonly recognized as E01, stores bit-stream disk images alongside embedded metadata including case numbers, examiner notes, and acquisition timestamps. It incorporates internal cryptographic hash digests, such as MD5 or SHA-1, to maintain evidence integrity. Additionally, the E01 structure supports lossless data compression algorithms to optimize storage capacity.

11. (B) 4 GB
The FAT32 file system architecture defines file sizes using a 32-bit field in its directory record entries. Consequently, the maximum theoretical length for any single file stored on a FAT32 volume is four gigabytes minus one byte, or approximately four gigabytes. Files exceeding this threshold require conversion to advanced file structures like exFAT or NTFS.

12. (B) NTFS
NTFS, the standard file system on modern Windows operating systems, relies on a centralized database called the Master File Table. The Master File Table holds records for every file and directory stored within the partition. Each record contains critical metadata, including system file permissions, MAC timestamps, cluster allocation maps, and security descriptors essential for system operations.

13. (A) The first character of the directory entry filename is changed to 0xE5
In File Allocation Table structures, deleting a file does not instantly wipe its content sectors. Instead, the file system replaces the initial character of the directory table filename entry with the hexadecimal byte 0xE5. The associated data clusters are flagged as unallocated, allowing forensic tools to recover file contents if those storage clusters remain unoverwritten.

14. (C) It marks the file's record in the Master File Table as inactive and available for new data
When a file is deleted within an NTFS partition, the file system changes the record status flag inside the Master File Table from active to inactive. The underlying data clusters on the disk are marked as unallocated within the cluster bitmap, making them available for future allocation without immediately clearing the existing raw storage bytes.

15. (D) Flash memory storage devices like USB drives and SD cards
The extended File Allocation Table architecture was designed as a lightweight file system optimized for removable flash memory media, including USB thumb drives and Secure Digital cards. It eliminates file allocation overhead found in standard FAT32 while avoiding the complex metadata structures and intensive disk logging overhead inherent to full NTFS implementations on flash memory.

16. (A) I, II and III are correct
File slack is the storage space between the end of a logical file and the end of its assigned physical cluster. It comprises RAM slack, which fills the unwritten bytes of the final sector, and drive slack, spanning remaining sectors in the cluster. Slack space regularly contains residual data from previous storage operations rather than zeros.

17. (B) ext4
The fourth extended file system is the default file system across most modern Linux operating system distributions. It provides structural improvements over earlier extended file systems, incorporating journal metadata features, extent-based file allocation algorithms, delayed block allocation, and support for massive storage volumes and files, making it standard for Linux environments.

18. (D) Resilient File System
ReFS stands for Resilient File System, introduced by Microsoft to maximize data availability, improve resilience against data corruption, and handle large volume capacities. It incorporates

Click Here to Buy book on Amazon

81. In the context of computer architecture, the "0x" prefix before a series of characters (such as 0xFFD8) indicates that the number is represented in which base system?
(A) Standard Binary number representation
(B) Hexadecimal system
(C) Standard Octal number representation
(D) Standard Decimal number representation

82. Which of the following best describes the principle of "Reproducibility" in digital forensic reporting?
(A) The technical report must be written in simple, non-technical language easily comprehended by laypersons
(B) The finalized documentation must strictly follow official standardized court filing paper and margin formats
(C) The physical storage evidence drive must be cloned at least three separate times prior to analytical processing
(D) Independent examiners using identical tools and evidence reach the same conclusion

83. The term "Data at Rest" in cybersecurity and digital forensics refers to data that is:
(A) Stored persistently on non-volatile media like hard drives
(B) Actively transmitting across internal local area network connections
(C) Temporarily loaded inside active system RAM for live CPU processing
(D) Being generated dynamically inside high-speed hardware CPU caches

84. In a standard NTFS volume, what is the default size of a Master File Table (MFT) record allocated for each file?
(A) 512 bytes
(B) 1024 bytes (1 KB)
(C) 4096 bytes (4 KB)
(D) 16 kilobytes (16 KB)

85. The command line utility `dd` is widely used in Linux environments for which primary forensic function?
(A) Creating a raw bit-for-bit image of storage media
(B) Executing dictionary and brute-force password cracking
(C) Capturing and analyzing live network packet transmissions
(D) Detecting hidden messages embedded within image files

86. When handling digital evidence in an Indian context, the forensic report generated by an authorized examiner of the State Forensic Science Laboratory is admissible as expert evidence under which section of the Bharatiya Nagarik Suraksha Sanhita?
(A) Section 164
(B) Section 173
(C) Section 329
(D) Section 356

87. A password attack that combines a dictionary list of common words with brute-force character variations (such as substituting 'a' with '@' or appending numbers) is known as a:
(A) Replay attack
(B) Hybrid attack
(C) Dictionary attack
(D) Phishing attack

88. What is the fundamental forensic issue with using standard "Ghost" cloning software to image a suspect's hard drive?
(A) Commercial cloning software automatically enforces proprietary encryption across image output formats
(B) Standard cloning utilities permanently alter the original file extension structures on the source disk
(C) It copies active files only, skipping unallocated space and deleted data
(D) Non-forensic cloning tools take several weeks to complete an acquisition due to lack of optimization

NODIA

89. Where is a file's "magic number" or file signature typically located within the file structure?
(A) Interspersed within the middle section of the raw data stream
(B) Located exclusively at the very end footer section of the file
(C) Stored directly inside the file name extension metadata structure
(D) At the beginning of the file header

90. When setting up a standard digital forensic laboratory according to official forensic guidelines, which of the following is a mandatory physical security requirement?
(A) Restricted access controls like biometrics with access logging
(B) Physical facilities must be constructed entirely below ground level to ensure structural isolation

a partition represents a larger logical volume division.

29. (A) RAM slack
RAM slack refers specifically to the unused storage bytes located within the final physical sector assigned to a file. When file data terminates prior to reaching the 512-byte sector boundary, older operating systems padded this gap with memory contents from system RAM, potentially capturing sensitive remnants of volatile data within storage structures.

30. (C) Slack space and unallocated disk space
Slack space and unallocated disk space represent prime storage regions for discovering residual file artifacts. Unallocated space holds storage blocks previously assigned to deleted files that have not yet been overwritten, while file slack stores residual data fragments from former operations, offering critical evidentiary value during digital forensic analysis and recovery operations.

31. (D) Overwriting unallocated disk clusters using specialized secure data wiping tools
Anti-forensics comprises technical measures designed to hamper, delay, or prevent digital forensic analysis. Secure data wiping tools actively execute anti-forensic measures by overwriting unallocated disk space and existing file records with random pattern passes or zeros. This process systematically destroys residual data, preventing examiners from recovering underlying evidence using standard file carving tools.

32. (C) Secure data wiping algorithms
DoD 5220.22-M is a widely recognized data sanitization standard published by the United States Department of Defense. It defines specific technical procedures for securely overwriting non-volatile storage hard drives using multi-pass patterns, including zero writes, one writes, and pseudorandom characters, ensuring complete data destruction beyond recovery by standard file carving or laboratory techniques.

33. (B) Steganography
Steganography is the science and art of concealing covert data within ordinary, unsuspicious cover media, such as image, audio, or video files. Unlike encryption, which transforms text into an unintelligible format, steganography hides the existence of the communication itself, making transmitted hidden information undetectable to casual observers and automated network monitoring controls.

34. (D) Modifying the least significant bit values of pixel data within a digital image file
Least Significant Bit manipulation is a steganographic technique that replaces the final binary bit of pixel color bytes with secret data bits. Because altering the lowest bit introduces imperceptible visual alterations to overall color shades, hidden payloads remain visually undetected while permitting target receivers to extract hidden data from media streams.

35. (A) Trying every possible character combination systematically until matching the password
A brute-force attack is an exhaustive password recovery method that systematically checks every potential permutation of characters, numbers, and symbols until discovering the valid password match. While guaranteed to succeed given infinite processing time, its computational complexity expands exponentially with key length, making long complex passwords resistant to exhaustive testing.

36. (C) Rainbow table attack
A rainbow table attack utilizes precomputed lookup tables containing plaintext strings paired with their calculated cryptographic hashes. By matching target password hashes against indexed precomputed chains, this technique trades disk storage space for extremely rapid execution speed, effectively bypassing runtime hash calculation delays inherent to conventional brute-force methodologies during offline credential recovery operations.

37. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Steganography and cryptography maintain fundamentally different operational goals. Cryptography protects data privacy by transforming legible plaintexts into unintelligible ciphertext formats using cryptographic algorithms, signaling the existence of secret content. Conversely, steganography conceals the presence of communication itself by embedding data within ordinary carrier files without creating obvious visual or structural anomalies.

Downloaded from www.pdf.tube

57. (B) Identification → Collection → Acquisition → Analysis → Reporting
Standard digital forensic frameworks follow a structured, sequential lifecycle. The process begins with Identification of potential evidence sources, followed by physical Collection and scene preservation. Next, bit-stream Acquisition captures evidence images, after which technical Analysis parses artifacts to discover facts. Finally, formal Reporting documents findings and methodologies for legal presentation.

58. (A) Isolate the system from the network to prevent remote wiping commands
When encountering a powered-on target machine during field operations, immediately isolating the device from active networks is crucial. Disconnecting Ethernet cables or isolating wireless connections prevents suspect users from issuing remote wiping commands, altering network-stored artifacts, or exfiltrating data, safeguarding local volatile memory and storage contents prior to volatile memory capture.

59. (B) When two distinct files yield the same output hash value
A hash collision occurs in cryptography when two separate, non-identical input datasets produce the exact same output hash value upon evaluation by a cryptographic hash function. Because cryptographic hashes should ideally yield unique digests for distinct inputs, collisions undermine the mathematical uniqueness guarantees required for data integrity verification in digital forensics.

60. (B) Memory (RAM) forensics and analysis
Volatility is an open-source advanced software framework designed specifically for volatile memory forensics and RAM analysis. It enables forensic examiners to analyze physical memory dumps acquired from live systems, extracting process trees, open network connections, kernel modules, command-line histories, loaded drivers, and decrypted security credentials without interacting directly with host hardware.

61. (A) The hash value will remain exactly the same
Cryptographic hash functions calculate output digests based strictly on the underlying binary stream contained within a file's content payload. File names are maintained separately as directory table or metadata attributes by the operating system. Consequently, modifying or renaming a filename without altering internal image data bytes leaves the computed cryptographic hash value unchanged.

62. (C) Volume Boot Record (VBR)
The Volume Boot Record is located at the first sector of an individual storage partition or file system volume. It contains specific execution code necessary to load the partition's operating system along with the BIOS Parameter Block, which defines partition layout parameters such as cluster size, sector counts, and file system metadata structures.

NODIA

63. (C) 3096 bytes
Storage allocation occurs in fixed-size blocks called clusters. When a file measuring 1000 bytes is written to a volume configured with 4096-byte clusters, the operating system allocates one full cluster. Subtracting the logical file size of 1000 bytes from the 4096-byte cluster allocation leaves 3096 bytes of unwritten cluster space, designated as file slack.

64. (A) I, II and III are correct
File carving extracts files from raw storage streams using known header and footer signatures independently of file system metadata. Because carving operates without structural cluster maps, highly fragmented files spanning non-contiguous sectors are difficult to reconstruct correctly. Furthermore, carving cannot bypass full disk encryption without access to appropriate decryption keys.

65. (B) It tracks cluster allocation status showing free and used clusters
The $Bitmap system file is a core metadata component within the NTFS file system. It contains a contiguous array of binary bits, where each bit corresponds directly to a specific cluster on the volume partition. A bit value of one indicates an allocated cluster, while zero marks a free or unallocated cluster available for writing.

66. (D) Inode
An inode is the core metadata data structure utilized by Linux and Unix file systems like ext3 and ext4. Each inode contains file metadata, including ownership attributes, access permissions, file size, MAC timestamps, and data block pointers. Notably, filenames are omitted from inodes and are managed separately within directory table entries.

remote data wipe signals, incoming calls, and cell tower network updates. Placing mobile devices inside a Faraday bag blocks wireless radio frequency transmissions, such as cellular, Wi-Fi, and Bluetooth signals, preserving internal flash memory artifacts in their original state until analytical isolation occurs.

48. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Instantly severing power to running systems destroys critical volatile memory contents, including active RAM data, network sockets, and process execution states. Furthermore, abruptly removing power from platforms employing full disk encryption like BitLocker causes encryption keys residing in volatile memory to vanish, permanently locking disk partitions and preventing future acquisition.

49. (B) $MFT
In the NTFS file system, the Master File Table, designated as $MFT, functions as the principal database tracking file metadata across the volume. Each file and directory on an NTFS partition possesses at least one 1024-byte MFT record detailing filename strings, attributes, file size, timestamps, security identifiers, and data cluster mapping pointers.

50. (D) It logs file system transactions before completion, helping reveal deleted or modified files
The $LogFile system metadata file acts as the transactional logging journal for NTFS volume operations. By recording metadata changes prior to committing structural updates to disk, $LogFile enables system recovery after crashes. Forensically, analyzing journal transactions reveals recent file creation, deletion, renaming, and attribute modification events even after primary MFT records are reused.

51. (A) A bit-for-bit copy of raw data without compression or case metadata
The Raw image format produces a complete bit-for-bit duplicate of target physical or logical storage media. It writes sequential sector bytes directly without applying proprietary metadata headers, examiner logs, compression algorithms, or internal hashing structures. Because raw images lack proprietary overhead, they remain widely compatible across open-source and commercial forensic analysis frameworks.

52. (C) State FSL Lucknow
In Uttar Pradesh, the primary state-level forensic facility responsible for advanced cyber investigations, digital device analysis, and multimedia forensic examinations is the State Forensic Science Laboratory located at Lucknow. Operating under the Directorate of Forensic Science, State FSL Lucknow serves as the primary technical nodal hub for processing electronic evidence for law enforcement agencies.

53. (A) P-4, Q-3, R-2, S-1
File systems are architected for specific target operating systems. NTFS serves as the primary default system for Windows, while ext4 forms the core Linux storage structure. APFS operates as Apple's proprietary file system for macOS systems, and FAT32 provides universal legacy compatibility across diverse hardware, digital cameras, and embedded platforms.

54. (B) 512 bytes
Traditional magnetic hard disk architecture organizes storage platters into circular tracks divided into individual physical sectors. Standard legacy drives establish 512 bytes as the baseline physical sector capacity for data addressing. Modern Advanced Format drives employ 4096-byte physical sectors while frequently maintaining 512-byte logical sector emulation for system software compatibility.

55. (A) I and II
Forensic write blockers safeguard media integrity during investigation workflows. They actively intercept and block command signals that write, modify, or alter data on the connected source storage drive. Simultaneously, write blockers allow read commands to pass unhindered, enabling examiners to read sectors, calculate hashes, and acquire exact bit-stream disk clones without metadata alteration.

56. (C) The image file is an exact, unaltered bit-stream copy of the source drive
Matching cryptographic hash digests computed independently from both a source storage device and its resulting forensic image file demonstrate data verification. Because cryptographic hashing produces unique output digests, matching values confirm that the acquired image file is an authentic, bit-for-bit duplicate containing identical physical binary content without modifications, loss, or artificial artifacts.

Click Here to Buy book on Flipkart

38. (D) Guidance Software (now OpenText)
EnCase is an established commercial digital forensics application suite originally created by Guidance Software, which was later acquired by OpenText Corporation. EnCase provides examiners with comprehensive software capabilities for evidence acquisition, bit-stream disk imaging, detailed file system analysis, deleted content recovery, timeline parsing, and court-admissible forensic reporting across multiple digital storage media platforms.

39. (B) The Sleuth Kit (TSK)
Autopsy is a prominent open-source digital forensics platform offering a graphical interface built over the underlying command-line library known as The Sleuth Kit. TSK provides low-level volume analysis utilities that enable Autopsy to parse volume structures, inspect raw file system details, extract metadata records, and carve deleted content from evidence images.

40. (A) P-3, Q-4, R-1, S-2
Forensic tools perform specialized analytical functions within investigation workflows. EnCase serves as a widely deployed commercial forensic suite, whereas Autopsy operates as an open-source graphical interface for volume examination. John the Ripper is a dedicated command-line password cracking tool, and OpenStego functions as a utility designed for steganographic data embedding and detection.

41. (C) Section 63
Under the Bharatiya Sakshya Adhiniyam, 2023, Section 63 lays down conditions regarding the admissibility of electronic records in Indian judicial proceedings. Replacing Section 65B of the former Indian Evidence Act, Section 63 specifies mandatory certificate requirements to establish the authenticity, integrity, device operational status, and legal validity of digital evidence introduced into court.

42. (B) I, II and III are correct
Chain of custody documentation provides a chronological log detailing the seizure, custody, transfer, analysis, and disposition of digital evidence. It identifies every individual handling the evidence, maintaining complete accountability to prevent defense claims of tampering or unauthorized access. Chain of custody records must be permanently retained to substantiate evidence integrity during legal trials.

43. (B) The methodology must be repeatable and reproducible by independent examiners
Scientific validity in digital forensic reporting demands that analytical methodologies remain both repeatable and reproducible. Independent forensic examiners, using identical scientific procedures and verified software toolsets on original evidence images, must produce identical results. Objective documentation of testing steps ensures that investigative conclusions withstand rigorous cross-examination within formal judicial proceedings.

44. (B) Physical extraction copies the entire drive bit-by-bit including unallocated space, while logical extraction copies only active files
Physical forensic extraction generates a complete bit-for-bit duplicate of storage hardware, capturing allocated files, unallocated disk sectors, slack space, and partition structures. In contrast, logical extraction interacts with system interfaces to copy active allocated files and directories, omitting raw sector data, deleted entries, and unallocated storage space from the acquired image file.

45. (A) hiberfil.sys
When a Microsoft Windows host enters hibernation mode, operating system kernel routines write the entire current contents of system volatile RAM into a hidden root file designated hiberfil.sys. Analyzing hiberfil.sys allows forensic examiners to reconstruct active system states, extracted unencrypted passwords, running processes, and network socket connections existing prior to device power-down.

46. (C) pagefile.sys
The Windows operating system utilizes pagefile.sys as secondary virtual memory when active physical RAM allocation limits are exceeded. Inactive physical memory pages containing document text fragments, network packets, process structures, and unencrypted credentials are automatically paged out onto the hard disk, providing forensic investigators with valuable memory remnants during disk analysis.

47. (D) Faraday bag
Seized mobile devices remain vulnerable to incoming radio communications, including

NODIA

67. (B) II, I, III, IV
Volatile data collection follows the order of volatility to minimize data loss. Processor registers and cache memory lose contents fastest when powered off, followed by system RAM. Dynamic network routing tables and connection states hold intermediate volatility, while non-volatile magnetic or solid-state hard disk drives retain persistent data permanently until overwritten or physically damaged.

68. (A) I and II
Data wiping software eliminates target disk data by overwriting raw sector storage blocks with zero bytes or random patterns. In modern drives, a single wiping pass overwriting sectors with zeros effectively prevents standard software-based forensic carving tools from recovering raw file data. Merely deleting directory entries leaves underlying data intact, whereas wiping overwrites contents.

69. (A) It appends random data to passwords, neutralizing precomputed rainbow table attacks
Salting involves appending a unique, random string of data to a user password prior to computing its cryptographic hash. This ensures that identical passwords yield distinct hash outputs. Salting effectively neutralizes precomputed rainbow table attacks, because attackers cannot utilize generic precomputed tables and must calculate custom hash chains for every unique salt value encountered.

70. (D) NTFS
Alternate Data Streams are a feature unique to the NTFS file system that allow files to attach multiple data streams to a single directory entry. While the primary stream holds main file contents, secondary alternate streams store additional data or metadata without modifying the primary file's visible size, creating potential avenues for hiding covert data.

71. (B) It misses deleted files, slack space, and unallocated disk areas
A logical copy extracts active allocated files and directories accessible through the file system interface. The primary forensic limitation of logical acquisition is that it skips raw storage areas. Consequently, deleted files, file slack space, unallocated clusters, and hidden partition metadata remain uncopied, depriving examiners of crucial residual evidence recoverable through physical bit-stream imaging.

72. (C) fls
The `fls` utility is a specialized command-line tool included within The Sleuth Kit. Its primary function is parsing directory structures within disk images to list file and directory entries. `fls` can identify and display deleted file records alongside active ones, providing inode or MFT metadata pointers necessary for subsequent analysis and carving operations.

73. (D) It resets file system structures while leaving file data in unallocated space
Executing a Quick Format on a storage partition recreates volume structures, such as clearing the file allocation table or initializing a fresh Master File Table. It removes logical directory references without overwriting raw sector contents. The existing file data remains stored within unallocated disk space, enabling forensic tools to reconstruct files through carving.

NODIA

74. (A) In a Class 100 cleanroom
Opening damaged hard drives to swap magnetic platters or replace failed read/write head assemblies exposes internal surfaces to airborne contaminants. Microscopic dust particles can cause catastrophic head crashes on platter media. Consequently, physical drive disassembly must be performed inside a Class 100 cleanroom environment, which filters microscopic particles to safeguard exposed platter surfaces.

75. (B) Symmetric encryption
Symmetric encryption algorithms utilize a single shared cryptographic key for both scrambling plaintext into ciphertext and decrypting ciphertext back into readable format. Common symmetric ciphers include Advanced Encryption Standard and Data Encryption Standard. Because both operations depend on the identical secret key, secure distribution and storage of that key remain critical for security.

76. (B) To calculate clock offset for accurate timestamp correlation
Hardware system clocks managed by system BIOS or UEFI firmware frequently drift or deviate from standard Coordinated Universal Time. Documenting the system hardware clock time during initial evidence examination allows examiners to compute the precise time offset.

(B) Placing the device inside a standard transparent plastic evidence storage bag
(C) Submerging the mobile device completely inside a container of distilled water
(D) Changing the system interface language and region configuration settings

20. Which type of mobile data acquisition interacts directly with the operating system's API to extract data such as contacts, call logs, and messages?
(A) Physical Acquisition
(B) Chip-off Extraction
(C) JTAG Extraction
(D) Logical Acquisition

21. Match the mobile identifiers in List I with their descriptions in List II:
List I: (Mobile Identifier)
P. IMEI
Q. IMSI
R. ICCID
S. MSISDN
List II: (Description)
1. Unique serial number printed on the physical SIM card
2. The dialable telephone number of the mobile subscriber
3. Unique physical identity of the mobile handset
4. Unique subscriber identity registered on the cellular network
(A) P-3, Q-1, R-4, S-2
(B) P-3, Q-4, R-1, S-2
(C) P-4, Q-3, R-1, S-2
(D) P-1, Q-4, R-3, S-2

22. In mobile forensics, acquiring the device's entire flash memory bit-by-bit to recover unallocated space and deleted files is known as:
(A) Logical Extraction
(B) File System Extraction
(C) Physical Extraction
(D) Network Extraction

23. File system acquisition of a mobile device generally provides more data than logical acquisition but often requires the device to be:
(A) Actively connected to a high-speed cellular or local Wi-Fi network
(B) Booted directly into factory recovery mode with data wiped
(C) Fully discharged and completely powered off with zero battery
(D) Rooted (for Android) or jailbroken (for iOS)

24. What does the acronym JTAG stand for in the context of mobile device physical extraction?
(A) Joint Test Action Group
(B) Java Telephony Architecture Gateway
(C) Junction Transfer Access Gate
(D) Joint Telecommunications Advanced Graphics

25. Which advanced physical extraction technique involves applying heat to desolder the flash memory chip directly from the mobile device's motherboard?
(A) Micro-read
(B) Chip-off
(C) ISP (In-System Programming)
(D) Logical bypass

26. Which of the following conditions poses the greatest challenge to recovering deleted data from modern smartphone flash memory?
(A) Implementation of legacy FAT32 or exFAT file allocation tables
(B) Execution of the flash controller TRIM command
(C) Presence of high-capacity removable MicroSD flash memory cards
(D) Total storage capacity of volatile system Random Access Memory

27. Consider the following statements regarding mobile data acquisition:
I. Logical acquisition typically copies files that are accessible via the operating system.
II. Physical acquisition captures a bit-by-bit image of the device's flash memory.
III. File system acquisition cannot access hidden databases and system files.
IV. Physical acquisition is generally faster than logical acquisition and requires no special access rights.
Which of the above statements are correct?
(A) I and II only
(B) I, III and IV only
(C) II, III and IV only
(D) I, II, III and IV

28. In iOS forensics, system settings and application configurations are most frequently stored in which file format?
(A) Android Package Kit (.apk) executable files
(B) Windows Portable Executable (.exe) binary files

Downloaded from www.pdf.tube

experts, including State Forensic Science Laboratory examiners. Replacing Section 293 of the former Code of Criminal Procedure, Section 329 enables courts to accept expert forensic opinion reports as valid evidence without requiring mandatory oral testimony in routine legal proceedings.

87. (B) Hybrid attack
A hybrid password attack merges dictionary techniques with targeted brute-force character rules. It takes baseline words from wordlist dictionaries and systematically applies rule-based mutations, such as appending numbers, altering capitalization, or performing character substitutions like replacing letters with symbols. This approach improves cracking efficiency compared to exhaustive pure brute-force searches across complex candidate passphrases.

88. (C) It copies active files only, skipping unallocated space and deleted data
Non-forensic cloning applications like standard Symantec Ghost are designed for system backup and deployment. They selectively copy active allocated file systems while bypassing unallocated sectors, deleted file structures, and file slack space. Consequently, using commercial backup cloning tools omits crucial residual evidence required for comprehensive forensic data recovery and analytical evaluation.

89. (D) At the beginning of the file header
A file magic number or file signature is a distinct sequence of identifying hexadecimal bytes positioned at the very beginning of a file header. Operating systems and forensic carving software inspect these initial header bytes to identify file formats independently of file name extensions, enabling accurate content identification and file classification during analytical extraction procedures.

90. (A) Restricted access controls like biometrics with access logging
Establishing a digital forensic laboratory requires strict physical security protocols to preserve evidence integrity and maintain chain of custody. Standards mandate secure perimeter access controls, such as biometric scanners or smart card readers, combined with automated access logging. These measures restrict entry exclusively to authorized personnel, preventing unauthorized evidence tampering, access, or contamination within laboratory facilities.

www.nodia.in

NODIA

This clock offset adjustment enables accurate correlation of file timestamps and event logs across multiple investigation sources.

77. (A) Every digital interaction leaves traceable evidence like logs and IP addresses
Locard's Exchange Principle asserts that contact between objects leaves physical trace evidence. In digital forensics, this principle manifests as digital footprints left during electronic interactions. Operating system actions, user activities, and network communications systematically generate logs, IP address records, registry updates, and temporal artifacts, providing verifiable evidence of digital interactions across connected devices.

78. (C) Digital photograph image files (.jpg / .tiff)
Exchangeable Image File Format, known as EXIF, is a standard for embedding metadata within digital image files, such as JPEG and TIFF formats. Captured automatically by digital cameras and smartphones, EXIF header tags record camera specifications, aperture settings, shutter speeds, timestamps, image resolution, and integrated GPS geolocation coordinates vital for investigative analysis.

79. (D) Embedded GPS coordinates specifying location
Modern mobile devices integrated with Global Positioning System receivers store spatial location data inside photograph metadata structures. When image capture occurs, EXIF tags automatically record geographical location coordinates, specifying exact latitude, longitude, and altitude details. Forensic parsing of EXIF data allows investigators to determine the precise physical location where an image was taken.

80. (C) Steganalysis
Steganalysis is the forensic science focused on detecting, analyzing, and extracting hidden information embedded within carrier media via steganography. Employing statistical detection algorithms, visual inspection tools, and file structure anomaly analysis, steganalysis aims to determine whether a target digital file contains concealed payloads and subsequently recover the hidden covert content.

81. (B) Hexadecimal system
In computer engineering and programming languages, the "0x" prefix denotes hexadecimal numerical values represented in base-16. Hexadecimal notation groups four binary bits into a single hexadecimal character ranging from 0 through F. This format provides a human-readable notation for inspecting raw binary data streams, disk sector offsets, memory addresses, and file header magic signatures.

82. (D) Independent examiners using identical tools and evidence reach the same conclusion
Reproducibility is a fundamental principle of scientific integrity in forensic reporting. It requires that independent examiners, using identical analytical toolsets, methodologies, and evidence image files, reproduce the exact same analytical findings and conclusions. Verification through reproducibility ensures that reported forensic evidence is objective, mathematically sound, and admissible in legal proceedings.

83. (A) Stored persistently on non-volatile media like hard drives
Data at Rest refers to information stored in persistent, non-volatile digital storage, such as magnetic hard drives, solid-state drives, optical media, or flash memory. Unlike data in transit moving across networks or data in use residing in active CPU caches, data at rest remains stationary on physical storage devices until accessed, retrieved, or modified.

84. (B) 1024 bytes (1 KB)
Within the NTFS file system, the Master File Table allocates a fixed record length for every file and folder on the partition. The default size of an individual MFT record is exactly 1024 bytes, or one kilobyte. This fixed allocation contains attribute headers, file identifiers, timestamps, and cluster mapping pointers for larger files.

85. (A) Creating a raw bit-for-bit image of storage media
The `dd` utility is a classic command-line tool in Linux and Unix systems used for low-level data copy and conversion operations. In digital forensics, `dd` reads raw sectors sequentially from source storage devices and writes them directly to target destination media, creating an uncompressed, bit-for-bit raw forensic disk image for analytical acquisition.

86. (C) Section 329
Under the Bharatiya Nagarik Suraksha Sanhita, 2023, Section 329 governs the admissibility of official reports issued by government forensic

Click Here to Buy book on Amazon

10. The first three digits of an International Mobile Subscriber Identity (IMSI) represent the:
(A) Mobile Network Code (MNC)
(B) Mobile Country Code (MCC)
(C) Mobile Station Identification Number (MSIN)
(D) Location Area Code (LAC)

11. Arrange the following components of a SIM card file system in logical hierarchical structure from the root directory to the lowest file level:
1. Dedicated File (DF)
2. Master File (MF)
3. Elementary File (EF)
(A) 2, 1, 3
(B) 1, 2, 3
(C) 2, 3, 1
(D) 3, 1, 2

12. In CDMA networks, which identifier serves a similar purpose to the IMEI used in GSM networks for identifying the mobile hardware?
(A) IMSI
(B) MSISDN
(C) MEID
(D) ICCID

13. Which technique is used to estimate the geographical location of a mobile phone by measuring the time delay or signal strength from three or more surrounding cell towers?
(A) IP Spoofing
(B) Packet Sniffing
(C) Frequency Hopping
(D) Trilateration

14. What does the term 'Tower Dump' refer to in mobile network investigations?
(A) The physical destruction or decommissioning of cell tower infrastructure to eliminate network logs and forensic evidence
(B) An automated cloud backup of all subscriber mobile device data directly to the cellular network provider's servers
(C) Telecom provider records of all mobile devices that connected to a specific cell tower during a given timeframe
(D) The complete formatting and firmware erasure of a cellular base station's internal Baseband Processing unit

15. Consider the following statements regarding GSM network architecture:
I. The Base Transceiver Station (BTS) handles the radio interface with the mobile station.
II. The Base Station Controller (BSC) manages a group of BTSs and handles radio channel allocation.
III. The Mobile Switching Centre (MSC) acts as the core switching node for the network.
Which of the above statements are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

16. Which of the following is typically NOT included in a standard Call Detail Record (CDR) provided by a telecom operator?
(A) The duration of the phone call
(B) The Cell ID of the tower used by the calling party
(C) The IMEI number of the handset used
(D) The actual audio recording of the conversation

17. The GPS standard format used to output geographical data, such as latitude, longitude, and satellite information, from a mobile receiver is:
(A) NMEA 0183
(B) IEEE 802.11
(C) ISO 9660
(D) TCP/IP

NODIA

18. When seizing a mobile phone that is found powered on and unlocked at a crime scene, what is the most appropriate immediate action for a forensic investigator?
(A) Power down the device immediately to preserve volatile system memory and save remaining battery charge
(B) Manually inspect chat applications to gather immediate investigative leads before turning the phone off
(C) Keep the device awake, isolate it from all wireless networks, and document the screen state
(D) Immediately remove the battery pack and SIM card without checking or photographing the active display

19. If a Faraday bag is unavailable at a crime scene, which of the following is an acceptable temporary method to isolate a mobile device from cellular networks?
(A) Wrapping the device tightly in aluminum foil

CHAPTER 33 33
Mobile Email And Internet Forensics

1. Which of the following best defines the primary scope of mobile device forensics?
(A) Recovering, analyzing, and presenting digital evidence from mobile devices in a forensically sound manner.
(B) Repairing damaged mobile device hardware and replacing internal components for commercial retail distribution.
(C) Developing secure mobile software applications with integrated end-to-end encryption network protocols.
(D) Intercepting live cellular calls, text messages, and network traffic without proper legal authorization.

2. In modern mobile device architecture, which component is primarily responsible for managing radio communications and maintaining the cellular network connection?
(A) Application Processor
(B) Graphics Processing Unit
(C) Baseband Processor
(D) Secure Enclave Processor

3. Which of the following operating systems uses the APFS (Apple File System) and is exclusively designed for Apple mobile devices?
(A) iOS
(B) Android
(C) Symbian
(D) HarmonyOS

4. What is a fundamental structural difference between the Android and iOS operating systems?
(A) iOS allows root-level file system access by default, whereas Android strictly prohibits it
(B) Android stores all application data in plaintext, whereas iOS encrypts all data
(C) iOS is entirely open-source, whereas Android is a fully closed-source proprietary system
(D) Android is built on a Linux kernel, whereas iOS is based on Darwin (a Unix-like core)

5. The ICCID is a unique identifier printed on a SIM card. What does ICCID stand for?
(A) International Cellular Communications Identity Document
(B) Integrated Circuit Card Identifier
(C) Internal Call Connection ID
(D) International CDMA Carrier Identifier

6. How many digits typically comprise a standard International Mobile Equipment Identity (IMEI) number, excluding any software version suffix?
(A) 12 digits
(B) 15 digits
(C) 16 digits
(D) 19 digits

7. The mathematical algorithm commonly used to calculate the 15th check digit of an IMEI number is known as the:
(A) RSA algorithm
(B) Diffie-Hellman algorithm
(C) SHA-256 algorithm
(D) Luhn algorithm

8. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Placing a seized mobile device in a Faraday bag is standard procedure before transporting it from a crime scene.
Reason (R): A Faraday bag prevents the device from connecting to cellular and Wi-Fi networks, mitigating the risk of data alteration or remote wiping.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

9. Which globally unique number is used to identify a mobile subscriber on a GSM network and is typically stored securely within the SIM card?
(A) MAC Address
(B) IMSI
(C) MEID
(D) BSSID

Downloaded from www.pdf.tube

(C) Property List (.plist) configuration files
(D) MS-DOS Batch Script (.bat) command files

29. In Android forensics, the command-line tool used to communicate with a connected Android device over USB for debugging and data extraction is called:
(A) Android Root Protocol (ARP)
(B) Secure Shell (SSH)
(C) File Transfer Protocol (FTP)
(D) Android Debug Bridge (ADB)

30. Which term refers to the state of an Apple iOS device that has been turned on but the user passcode has not yet been entered, keeping the file system heavily encrypted?
(A) AFU (After First Unlock)
(B) DFU (Device Firmware Update)
(C) BFU (Before First Unlock)
(D) Recovery Mode

31. What is a "Smudge Attack" in the context of bypassing mobile device locks?
(A) Injecting malicious command payloads through a compromised hardware USB charging port
(B) Analyzing oily finger residues on the glass screen to infer pattern locks
(C) Overloading volatile system memory (RAM) buffer limits to bypass the lock screen
(D) Applying specialized chemical compounds to dissolve and compromise the fingerprint sensor

32. Select the correct chronological sequence of steps for the standard forensic handling of a powered-on mobile device found at a crime scene:
(A) Photograph the screen, Isolate from networks, Package in Faraday bag, Transport to laboratory
(B) Isolate from networks, Photograph the screen, Perform Logical Extraction, Package in Faraday bag
(C) Package in Faraday bag, Photograph the screen, Transport to laboratory, Perform Physical Extraction
(D) Perform Logical Extraction, Photograph the screen, Package in Faraday bag, Transport to laboratory

33. On an Android device, short message service (SMS) texts and multimedia messages (MMS) are typically stored in which type of database?
(A) SQLite Database
(B) Microsoft Access Database
(C) MySQL Database
(D) Oracle Database

NODIA

34. In SQLite databases commonly found in mobile applications, temporary files used for transaction rollbacks and crash recovery, which may contain recently deleted data, are known as:
(A) Primary relational B-tree database index files
(B) Temporary application performance cache files
(C) Write-Ahead Log (WAL) transaction files
(D) Unformatted raw hexadecimal system storage files

35. When investigating WhatsApp data on a seized Android phone, the primary unencrypted database file containing chat histories is usually named:
(A) msgstore.db
(B) chat.db
(C) whatsapp.sqlitedb
(D) messages.xml

36. Which of the following best describes the principle of Locard's Exchange Principle as applied to digital mobile forensics?
(A) Electronic data cannot be created or destroyed, but merely converted from one format to another
(B) Digital evidence is legally inadmissible in court unless the original hardware device is physical present
(C) Telecommunications network traffic consistently routes data packets across the shortest geographic path
(D) Every contact with a digital system leaves digital traces and carries digital traces away

37. Which of the following is a common artefact left behind by social media applications like Facebook or Instagram on a mobile device?
(A) Master Boot Record (MBR) partition modifications
(B) Cached thumbnails of viewed media files
(C) Windows Registry system hive configuration changes
(D) Physical network hardware MAC address alterations

38. Consider the following statements regarding email protocols:
I. SMTP is the standard protocol used

photo capture

75. Consider the following statements regarding VoIP and Internet forensics:
I. SIP (Session Initiation Protocol) is primarily responsible for transmitting the actual voice audio data.
II. RTP (Real-time Transport Protocol) is used to establish and terminate the VoIP call session.
III. WebRTC allows audio and video communication directly within web browsers without external plugins.
IV. VoIP communications are completely immune to packet sniffing and interception due to default hardware encryption.
Which of the above statements are incorrect?
(A) I, II, and IV
(B) II, III, and IV
(C) I, II, and III
(D) I, III, and IV

76. In Voice over IP (VoIP) forensics, which protocol is standardly used for setting up, connecting, and tearing down a call session?
(A) RTP (Real-time Transport Protocol)
(B) FTP (File Transfer Protocol)
(C) SIP (Session Initiation Protocol)
(D) SMTP (Simple Mail Transfer Protocol)

77. Which of the following is the most significant challenge in analyzing Voice over IP (VoIP) traffic captured via a network packet sniffer like Wireshark?
(A) VoIP communication relies on purely analog radio signals that cannot be digitized
(B) VoIP network data packets lack standard source and destination IP header addresses
(C) Wireshark network analyzer tools are fundamentally incapable of capturing UDP packets
(D) Modern VoIP session traffic is encrypted using security protocols like SRTP

78. Which of the following correctly identifies the distinction between the Surface Web, Deep Web, and Dark Web?
(A) Surface Web is encrypted, Deep Web is fully unencrypted, and Dark Web is restricted to military communication networks
(B) Surface Web requires Tor, Deep Web uses I2P, and Dark Web content is publicly indexed by standard Google search crawlers
(C) Surface Web is indexed, Deep Web is unindexed web content, and Dark Web requires routing software like Tor
(D) There is no structural technical distinction; all three terms represent media buzzwords describing one unified global internet network

79. Match the email storage artefact in List I with its description in List II:
List I: (Email Storage Artefact)
P. PST
Q. OST
R. EML
S. MBOX
List II: (Description)
1. Offline storage table file used by Microsoft Exchange/Outlook
2. Standard file format for storing a single raw email message
3. Personal storage table file used for local archiving in Microsoft Outlook
4. Text file format storing a collection of emails concatenated together
(A) P-1, Q-3, R-2, S-4
(B) P-3, Q-1, R-2, S-4
(C) P-3, Q-2, R-1, S-4
(D) P-3, Q-1, R-4, S-2

80. The most prominent network utilized to access the Dark Web, which provides anonymity by routing traffic through multiple encrypted nodes, is called:
(A) The VPN Network
(B) The Intranet
(C) The Surface Protocol
(D) The Tor Network

81. In the Tor network architecture, the computer that serves as the final relay point before the traffic enters the regular internet is known as the:
(A) Exit Node
(B) Entry Guard
(C) Middle Relay
(D) Dark Router

82. Consider the following statements regarding the Dark Web:
I. The Dark Web requires special routing software, such as Tor, for access.
II. 'Onion routing' provides anonymity by encrypting traffic through multiple relays, peeling back layers of encryption at each step.

Click Here to Buy book on Flipkart

(B) The Header and the Body
(C) The Envelope and the Payload
(D) The Signature and the Ciphertext

48. Match the web browser in List I with its primary local history database file format in List II:
List I: (Web Browser)
P. Google Chrome
Q. Mozilla Firefox
R. Internet Explorer (older versions)
S. Apple Safari
List II: (Database File Format)
1. places.sqlite
2. History.db
3. Index.dat
4. History (SQLite format)
(A) P-1, Q-4, R-3, S-2
(B) P-4, Q-2, R-3, S-1
(C) P-3, Q-1, R-4, S-2
(D) P-4, Q-1, R-3, S-2

49. When tracing the origin of an email, which section of the email header provides the most reliable chronological path taken by the email through various servers?
(A) Received header lines
(B) Subject header text field
(C) Originating From header field
(D) Destination To header field

50. Consider the following statements regarding email headers:
I. The 'Message-ID' header is a unique identifier generated by the originating mail program or server.
II. The 'Received' headers show the path the email took from sender to receiver.
III. To trace the chronological path of an email, 'Received' headers are read from bottom to top.
IV. The 'Return-Path' indicates the email address where bounce messages should be sent.
Which of the above statements are correct?
(A) I, II, and III only
(B) II, III, and IV only
(C) I, III, and IV only
(D) I, II, III, and IV

51. In email forensics, the IP address identified as the true point of origin for a sent message is often found in the header field labeled:
(A) X-Originating-IP
(B) Target-IP
(C) Destination-Routing-IP
(D) Spoof-IP

52. The malicious practice of altering the 'From' address in an email header so that the message appears to come from someone other than the actual sender is known as:
(A) Credential phishing
(B) Unsolicited email spamming
(C) Telecommunication wiretapping
(D) Email header spoofing

53. Which DNS record type is commonly used by organizations to specify which mail servers are authorized to send email on behalf of their domain, helping to prevent email spoofing?
(A) A Record
(B) SPF Record
(C) CNAME Record
(D) PTR Record

54. A highly targeted phishing attack aimed specifically at senior executives or high-profile individuals within an organization is known as:
(A) Vishing
(B) Smishing
(C) Whaling
(D) Pharming

55. Select the standard order of the email routing process from sender to receiver:
(A) MUA → MTA → MDA → MUA
(B) MTA → MUA → MUA → MDA
(C) MDA → MTA → MUA → MTA
(D) MUA → MDA → MTA → MUA

56. The proprietary file format used by Microsoft Outlook to store copies of messages, calendar events, and other items locally on a user's computer for offline access is called:
(A) OST (Offline Storage Table)
(B) EML (Electronic Mail Format)
(C) MBOX (Mailbox Format)
(D) DBX (Outlook Express Database)

57. The Microsoft Outlook PST file stands for:
(A) Primary Server Table
(B) Personal Storage Table
(C) Private Security Token
(D) Public Server Transmission

58. Which of the following file formats stores a collection of emails concatenated together as plain text, commonly used by Mozilla Thunderbird and Unix-based mail systems?

Downloaded from www.pdf.tube

primarily for sending outgoing emails.
II. POP3 downloads emails from the server to the client and by default deletes them from the server.
III. IMAP synchronizes the email client with the remote server, allowing access from multiple devices.
Which of the above statements are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

39. Cloud backup analysis of an iOS device involves extracting data from which Apple service?
(A) OneDrive
(B) Google Drive
(C) Dropbox
(D) iCloud

40. In order to extract data from a suspect's cloud backup (e.g., Google Drive or iCloud) without their password, an investigator typically requires a valid:
(A) Device-extracted authentication token
(B) International Mobile Equipment Identity (IMEI) serial number of the handset
(C) Media Access Control (MAC) physical address of the suspect's primary home router
(D) Personal Unblocking Key (PUK) code retrieved from the physical SIM card

41. Which of the following is an industry-standard commercial mobile forensic tool developed by Cellebrite?
(A) XRY Mobile Device Forensic Extraction and Analysis Suite
(B) UFED (Universal Forensic Extraction Device)
(C) Oxygen Forensic Detective Multi-Platform Solution
(D) EnCase Digital Forensics Examination Software

42. In mobile forensics, what does the tool 'XRY' specialize in?
(A) Recovering deleted file partitions from traditional mechanical computer hard disk drives
(B) Extracting and analyzing digital evidence from mobile devices and smartwatches
(C) Tracing anonymous cryptocurrency transactions across decentralized dark web networks
(D) Performing automated biological DNA sequence matching and genetic profile analysis

43. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Physical extraction generally recovers more deleted data than logical extraction.
Reason (R): Physical extraction creates a bit-level copy of the entire flash memory, including the unallocated space where deleted data residues exist.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

44. The email system architecture component responsible for securely routing an email from the sender's mail server to the recipient's mail server over the internet is the:
(A) Mail User Agent (MUA)
(B) Mail Delivery Agent (MDA)
(C) Mail Transfer Agent (MTA)
(D) Internet Service Provider (ISP)

NODIA

45. Which network port is traditionally used by the Simple Mail Transfer Protocol (SMTP) for sending unencrypted email?
(A) Port 21
(B) Port 25
(C) Port 80
(D) Port 443

46. What is the primary function of the 'Mail User Agent' (MUA) in email architecture?
(A) To dynamically route email messages through intermediate internet backbone gateways
(B) To inspect and filter out spam messages and malicious email attachments at the server level
(C) To provide the user interface for composing, reading, and managing email communications
(D) To resolve human-readable domain names into network IP addresses via DNS querying

47. An email message fundamentally consists of two main parts. What are they?
(A) The IP Address and the MAC Address

67. If a suspect used Private Browsing mode, where might a forensic investigator still find traces of the visited websites immediately after the session?
(A) In the local DNS resolver cache and active RAM
(B) In the browser's persistent SQLite history database
(C) In the ISP's billing address database
(D) In the local Windows registry SAM file

68. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Browsing the internet in 'Incognito' or 'Private' mode leaves absolutely no trace of user activity on the local computer once the browser is closed.
Reason (R): Private browsing mode relies heavily on volatile memory (RAM) and the local DNS cache, remnants of which can often be recovered before a system reboot.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

69. Which command-line utility is commonly used by investigators to trace the network path and identify the routers between a source computer and a destination IP address?
(A) ping utility command
(B) traceroute command
(C) ipconfig / displaydns
(D) netstat network tool

70. IP geolocation is the process of mapping an IP address to a physical location. Which of the following is true regarding IP geolocation?
(A) Pinpoints exact room-level GPS geographic coordinates of the target user hardware device
(B) Functions exclusively when querying modern IPv6 address space network configurations
(C) Identifies country, region, and ISP, requiring ISP subscriber logs for exact address
(D) Violates statutory privacy laws when accessed by authorized digital forensic investigators

71. Arrange the following hardware components involved in a mobile Chip-off extraction in the correct sequence of operation:
1. Reballing or cleaning the memory chip contacts
2. Reading the chip in an external specialized programmer
3. Desoldering the memory chip from the motherboard
4. Logical reconstruction of the raw physical image using forensic software
(A) 3, 1, 2, 4
(B) 1, 3, 2, 4
(C) 3, 2, 1, 4
(D) 2, 3, 1, 4

72. Internet Service Providers (ISPs) in India are required to maintain user IP allocation logs and subscriber records for a specific period. These records map a dynamic IP address to a specific user using which critical parameter?
(A) Exact timestamp of the dynamic IP lease assignment
(B) Hardware dimensions and physical weight of the wireless router
(C) Manufacturer brand name and model of the user's mobile phone
(D) Total byte size of outbound email message attachments sent

73. Server logs are crucial in internet forensics. Which of the following is the standard format used by Apache web servers to record client requests?
(A) Extensible Markup Language (XML)
(B) Common Log Format (CLF)
(C) JavaScript Object Notation (JSON)
(D) Personal Storage Table (PST)

74. In social media forensics, when analyzing an image uploaded to platforms like Facebook or WhatsApp, why is the original EXIF data (like GPS location of the photo) often missing?
(A) Social media platforms re-encode and encrypt all uploaded images using AES-256 protocols
(B) Platforms strip EXIF metadata during image compression for privacy and storage optimization
(C) EXIF metadata transmission across public internet networks is strictly prohibited by law
(D) Mobile camera applications automatically delete EXIF metadata immediately after

Click Here to Buy book on Amazon

or remotely wiping internal device storage before digital extraction occurs.

9. (B) IMSI
The International Mobile Subscriber Identity represents a fifteen-digit number allocated to cellular subscribers to uniquely identify their accounts within global networks. Securely stored inside the SIM card, this identity consists of country, network, and individual subscriber codes, enabling cellular infrastructure nodes to authenticate users, manage roaming capabilities, and establish billing channels whenever a connection request is initiated.

10. (B) Mobile Country Code (MCC)
International network subscriber identification numbers begin with a three-digit sequence defined by the ITU-T E.212 recommendation as the Mobile Country Code. This initial numerical segment specifies the subscriber's country of origin, allowing international telecommunications networks to properly route cellular traffic, handle domestic roaming operations, and accurately process international communication linkages between different participating nations.

11. (A) 2, 1, 3
The file structure of a Subscriber Identity Module follows an ISO/IEC 7816 hierarchical standard organized into three distinct levels. At the apex resides the Master File, acting as the root directory. Beneath it sit Dedicated Files, serving as intermediate subdirectories that group operational domain files, under which Elementary Files reside to store actual data entries such as contacts and messages.

12. (C) MEID
In CDMA telecommunication environments, the Mobile Equipment Identifier serves as a globally unique 56-bit binary code assigned to physical handset hardware. Introduced to replace shorter legacy electronic serial numbers, this identifier fulfills the identical structural function in CDMA systems that the International Mobile Equipment Identity performs in GSM networks by uniquely establishing physical device identity.

13. (D) Trilateration
Trilateration is a geometric location estimation technique utilized in network investigations to calculate the geographic position of a target mobile device. By evaluating relative distance parameters—such as signal propagation delay or received signal strength—from three or more surrounding cellular base stations with known physical locations, analysts can construct intersecting coverage circles to pinpoint device coordinates accurately.

14. (C) Telecom provider records of all mobile devices that connected to a specific cell tower during a given timeframe
A cell tower dump is an investigative record provided by telecommunications operators containing historical connection logs generated by a specific cellular tower during a defined time window. These comprehensive logs document call activity, text messaging transactions, and data connections made by all mobile devices within range, allowing investigators to identify potential suspects or witnesses present at a scene.

NODIA

15. (D) I, II and III
GSM network architecture relies on specialized functional nodes working in tandem. The Base Transceiver Station manages direct radio frequency transmission with mobile handsets. The Base Station Controller manages multiple transceiver stations, allocating radio channels and controlling handovers. Finally, the Mobile Switching Centre functions as the primary switching core, routing voice calls, handling signaling, and managing subscriber mobility features.

16. (D) The actual audio recording of the conversation
Call Detail Records generated by telecommunication service providers capture metadata associated with network transactions for administrative, billing, and technical tracking purposes. Standard CDR logs store details including calling and receiving numbers, call start time, connection duration, hardware identifiers, and connecting cell tower IDs. Crucially, these administrative transactional logs do not contain live audio recordings or message content.

17. (A) NMEA 0183
The NMEA 0183 specification, established by the National Marine Electronics Association, serves as the standard data communications protocol for transmitting positional information between satellite navigation receivers and electronic devices. Mobile GPS hardware outputs spatial coordinates, speed, altitude, timestamp, and active satellite constellation details formatted

III. Cryptocurrencies like Bitcoin are rarely used on the Dark Web because they leave a permanent public ledger trace.

Which of the above statements are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

83. The process of recovering an intentionally deleted SMS from a mobile device relies primarily on the fact that:
(A) Deletion removes pointer references, leaving data in unallocated space until overwritten
(B) Cellular network service providers transmit duplicate copies of all user text messages directly to law enforcement agencies
(C) Modern mobile phone display screens retain latent electrical ghost images of recently deleted user text messages
(D) Deleted SMS messages are automatically converted and forwarded to the mobile device user's synchronized cloud email account

84. Which directory within an Android file system typically contains the databases for user contacts and call logs (assuming root access is obtained)?
(A) /system/app/
(B) /sdcard/DCIM/
(C) /boot/grub/
(D) /data/data/

85. During a network forensics investigation, an investigator examines an HTTP server log entry: `192.168.1.50 - - [10/Oct/2023:13:55:36 +0000] "GET /index.html HTTP/1.1" 200 1043`. What does the "200" signify?
(A) The byte size of the file downloaded from the server
(B) HTTP status code indicating a successful request
(C) The network port number utilized by the requesting client
(D) The cryptographic encryption standard applied to the session

86. Which section of the Information Technology Act, 2000 (India) primarily deals with the punishment for sending offensive messages through communication services, though it was notably struck down by the Supreme Court?
(A) Section 43
(B) Section 65
(C) Section 66A
(D) Section 67

87. An investigator receives an anonymous email threatening a citizen in Uttar Pradesh. To establish the origin, the investigator requests the ISP subscriber details for the sender's IP address. Which standard process in India governs the lawful request of such data by law enforcement?
(A) Filing an official Right to Information (RTI) application directly to the designated ISP
(B) Executing an immediate physical search and seizure raid on the ISP operational headquarters
(C) Instructing the victim to send a reply email formally demanding the sender's real IP address
(D) Issuing a legal notice under Section 91 CrPC / Section 94 BNSS to the service provider

88. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): JTAG extraction involves physically removing the flash memory chip from the mobile device's printed circuit board.
Reason (R): The JTAG technique connects to standard test access ports on the motherboard to access the processor and memory without requiring component desoldering.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

89. In mobile forensics, bypassing a screen lock via 'Brute Force' involves:
(A) Applying localized heat to the device display panel until the touch digitizer fails
(B) Systematically attempting all passcode combinations until the correct key is found
(C) Utilizing high-magnification electron microscopes to inspect raw flash memory cells
(D) Subjecting the suspect to psychological coercion until they reveal their password

90. Which of the following is the odd one out with respect to mobile operating systems?
(A) Android
(B) Oracle
(C) iOS
(D) HarmonyOS

Downloaded from www.pdf.tube

(A) PST
(B) MBOX
(C) DBX
(D) OST

59. When investigating webmail (e.g., Gmail accessed via a web browser), where is the investigator most likely to find fragments of drafted or viewed emails on the local machine?
(A) Browser cache and virtual system memory files
(B) Local Microsoft Outlook PST archive files on disk
(C) Windows Registry Security Accounts Manager (SAM) hive
(D) Local Thunderbird or Unix MBOX database file

60. Match the digital forensic tool in List I with its primary developer/manufacturer in List II:
List I: (Forensic Tool)
P. UFED
Q. XRY
R. Oxygen Forensic Detective
S. Axiom
List II: (Developer/Manufacturer)
1. MSAB
2. Cellebrite
3. Magnet Forensics
4. Oxygen Forensics
(A) P-1, Q-2, R-3, S-4
(B) P-2, Q-4, R-1, S-3
(C) P-2, Q-1, R-4, S-3
(D) P-4, Q-1, R-2, S-3

61. The process of analyzing web browser artefacts to determine user behavior heavily relies on examining the browser cache. What is the primary purpose of a browser cache?
(A) Securely storing user authentication passwords using 256-bit AES encryption algorithms
(B) Automatically and permanently purging local browsing logs when closing browser windows
(C) Anonymizing user activity by hiding public IP addresses from internet service providers
(D) Temporarily saving web page assets on the local drive to accelerate future loading times

62. Consider the following statements regarding web browser artefacts:
I. The browser cache stores temporary internet files to speed up page loading on return visits.
II. Cookies are small text files created by websites to store user session data and preferences.
III. Autofill data stores user-entered information from web forms for convenience.
Which of the above statements are correct?
(A) I and II only
(B) I and III only
(C) II and III only
(D) I, II and III

NODIA

63. Small files placed on a user's computer by a web server to track the user's session, preferences, and browsing habits are known as:
(A) Bookmarks
(B) Cookies
(C) Plugins
(D) Applets

64. When a user creates a 'Bookmark' or 'Favorite' in their web browser, the forensic significance is that it generally indicates:
(A) An inadvertent user click on a malicious browser pop-up window or redirect
(B) A restricted website blocked automatically by the endpoint network firewall
(C) A compromised website that infected the local host with ransomware payloads
(D) A site intentionally saved by the user for future reference, showing interest

65. In modern versions of the Windows Operating System, which browser artefact file stores the history and cache metadata for Microsoft Edge and Internet Explorer?
(A) WebCacheV01.dat
(B) Legacy Internet Explorer index.dat file
(C) Mozilla Firefox places.sqlite file
(D) Google Chrome history.db file

66. A user browses the internet using 'Incognito' or 'Private Browsing' mode. Which of the following artefacts is NOT typically saved to the hard drive's browser history database after the session is closed?
(A) Files manually downloaded by the user during the session
(B) Bookmarks manually created during the session
(C) The URLs of the websites visited
(D) Changes made to the computer's operating system settings

ANSWERS

1. (A) Recovering, analyzing, and presenting digital evidence from mobile devices in a forensically sound manner.
Mobile device forensics encompasses the scientific recovery, preservation, analysis, and presentation of digital evidence residing on handheld communication devices. This discipline ensures that evidence extracted from smartphones, tablets, and SIM cards maintains legal admissibility in judicial proceedings. Qualified forensic examiners utilize validated technical tools and methodologies to preserve digital integrity throughout the entire investigative process.

2. (C) Baseband Processor
Modern smartphone architectures separate cellular communications from general software execution by employing two dedicated processors. The baseband processor possesses its own real-time operating system, firmware, and processing units designed exclusively to handle radio frequency signals, cellular protocol stacks, and network registrations. This dedicated hardware component manages cellular connectivity independently from the primary application processor that handles user interface tasks.

3. (A) iOS
Apple introduced the Apple File System as a proprietary 64-bit architecture designed to optimize flash and solid-state storage performance across its hardware ecosystem. Operating systems deployed on Apple mobile devices rely exclusively on this optimized file system to provide strong encryption, space sharing, cloning, fast directory sizing, and atomic safe-save operations, making it central to iOS device architecture.

4. (D) Android is built on a Linux kernel, whereas iOS is based on Darwin (a Unix-like core)
The fundamental architectural difference between major mobile operating platforms lies in their core operating system kernels. Android relies on a modified version of the open-source Linux kernel to handle system resources, hardware abstraction, and process execution. Conversely, iOS is built upon Darwin, an open-source Unix-like operating system kernel developed by Apple that incorporates XNU components and BSD sub-systems.

5. (B) Integrated Circuit Card Identifier
The acronym ICCID represents the Integrated Circuit Card Identifier, which serves as a globally unique physical identification number assigned to every Subscriber Identity Module card. Comprising up to nineteen or twenty digits, this standardized string is laser-engraved onto the physical plastic card during manufacturing and stored within the card file system to identify the hardware itself internationally.

6. (B) 15 digits
An International Mobile Equipment Identity number consists of a standardized fifteen-digit numeric sequence designed to uniquely identify individual physical handsets on GSM networks. This numerical structure includes an eight-digit Type Allocation Code, a six-digit Serial Number, and a final check digit calculated using the Luhn algorithm, providing network operators with a reliable device authentication mechanism worldwide.

7. (D) Luhn algorithm
The verification digit situated at the fifteenth position of a standard hardware identifier is derived using the Luhn algorithm, also known as the Modulus 10 formula. This simple checksum algorithm protects telecommunication systems and commercial credit networks against accidental transcription errors by performing mathematical operations across alternating digits within the identification number to validate its structural authenticity.

8. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Isolating a mobile communication device from radio signals is critical for preserving evidence during crime scene investigations. A Faraday bag creates an electromagnetic shield using conductive materials that block all incoming and outgoing RF transmissions. Severing active wireless connections prevents external parties or automated routines from modifying, overwriting,

Click Here to Buy book on Flipkart

www.nodia.in

NODIA

as ASCII text sentences governed by this standardized interface specification.

18. (C) Keep the device awake, isolate it from all wireless networks, and document the screen state
Discovering an unlocked mobile device requires immediate action to protect volatile memory and bypass potential lock re-engagement. Investigators must keep the screen active, document visible on-screen evidence photographically, and immediately block incoming radio frequency signals. Placing the hardware into flight mode or an isolation enclosure prevents remote wiping commands or state alterations while maintaining device accessibility.

19. (A) Wrapping the device tightly in aluminum foil
When commercial radio frequency shielding enclosures are unavailable at a crime scene, wrapping a mobile device in multiple layers of heavy-duty aluminum foil serves as an effective field alternative. Aluminum forms a temporary Faraday cage that attenuates electromagnetic signals, effectively blocking incoming cellular, Wi-Fi, Bluetooth, and GPS transmissions from reaching the internal antenna.

20. (D) Logical Acquisition
Logical acquisition involves requesting data from a mobile device by communicating directly with its operating system application programming interfaces. The device OS processes these standardized extraction requests and returns visible, structured data items such as phonebooks, call logs, text messages, and media files. Because it relies on OS software, deleted or unallocated data is generally excluded.

21. (B) P-3, Q-4, R-1, S-2
Mobile identifiers fulfill specific technical roles across cellular infrastructure. The IMEI acts as the unique physical hardware number for the handset. The IMSI identifies the individual network subscriber account stored on the SIM. The ICCID represents the distinct serial number engraved on the physical SIM card. Finally, the MSISDN denotes the actual dialable phone number.

22. (C) Physical Extraction
Physical extraction creates a bit-for-bit duplicate image of the mobile device's underlying flash memory modules. By bypassing the operating system and reading raw memory sectors directly, this extraction method captures active file structures alongside unallocated storage spaces, system partitions, and wear-leveled blocks, enabling forensic examiners to recover deleted files, hidden databases, and residual data artifacts.

23. (D) Rooted (for Android) or jailbroken (for iOS)
File system acquisition extracts complete folder hierarchies, application databases, and hidden configuration files directly from device storage partitions. Mobile operating systems employ strict privilege separation and sandbox security models that restrict access to protected data directories. Consequently, obtaining full file system access often requires gaining elevated privileges by rooting Android devices or jailbreaking iOS hardware prior to extraction.

24. (A) Joint Test Action Group
JTAG is an industry acronym for the Joint Test Action Group, an electronics association that developed standardized boundary-scan testing protocols under IEEE 1149.1. In forensic hardware examinations, investigators solder fine wires directly onto physical JTAG test access points located on a smartphone printed circuit board to communicate directly with processor registers and extract raw memory.

25. (B) Chip-off
Chip-off extraction represents an advanced, destructive physical recovery technique where the non-volatile NAND or eMMC flash memory chip is unsoldered from the circuit board using specialized heating apparatuses. Once removed and thoroughly cleaned, the standalone memory chip is mounted into an external hardware reader to acquire raw binary data images, bypassing device encryption and damaged hardware components.

26. (B) Execution of the flash controller TRIM command
The TRIM command implemented within modern flash memory controllers severely hinders forensic deleted data recovery. When a user deletes a file, the operating system sends TRIM instructions informing the solid-state controller that specific memory blocks are no longer needed. The controller automatically erases and zero-fills those blocks during garbage

NODIA

(D) A continuous biometric hash sequence

8. Read the following statements regarding the Information Technology Act, 2000 and select the correct option:
Assertion (A): Under the IT Act, a digital signature is created using an asymmetric crypto system and hash function.
Reason (R): The hash function uniquely transforms an electronic record into another electronic record, and any change in the original record will result in a completely different hash value.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

9. Under the Information Technology Act, 2000, a person who sends, generates, stores or transmits any electronic message or causes any electronic message to be sent, generated, stored or transmitted is known as the:
(A) Addressee
(B) Intermediary
(C) Subscriber
(D) Originator

10. Which section of the Information Technology Act, 2000 provides legal recognition to electronic records, stating that information shall not be denied legal effect solely on the ground that it is in the form of an electronic record?
(A) Section 3
(B) Section 4
(C) Section 5
(D) Section 6

11. What is the fundamental difference between a "Digital Signature" and an "Electronic Signature" under the Information Technology Act, 2000?
(A) Digital signatures utilize specialized biometric verification methods, whereas electronic signatures rely strictly on symmetric secret key algorithms.
(B) Digital signatures rely on asymmetric cryptosystems and hash functions, whereas electronic signatures include other scheduled reliable techniques.
(C) Digital signatures are legally enforceable only in international cross-border trade, while electronic signatures govern domestic matters in India.
(D) There is no functional or legal distinction between the two terms, as both were used completely interchangeably throughout the original 2000 Act.

12. Consider the following statements regarding the authentication of electronic records under Section 3 of the Information Technology Act, 2000:
I. An electronic record can be authenticated by affixing a digital signature.
II. The authentication relies on an asymmetric crypto system and hash function.
III. The private key and the public key are unique to the subscriber.
IV. Any person cannot verify the electronic record by retaining the public key of the subscriber.
Which combination of the above statements is incorrect?
(A) I and II only
(B) III and IV only
(C) IV only
(D) II and IV only

13. Which section of the Information Technology Act, 2000 accords legal recognition to electronic signatures, equating them with traditional handwritten signatures for the purpose of law?
(A) Section 3A
(B) Section 4
(C) Section 5
(D) Section 7

14. In the context of the attribution of electronic records (Section 11 of the Information Technology Act, 2000), an electronic record is NOT attributed to the originator if it was sent by:
(A) The originator himself acting directly in his personal or official capacity
(B) A person who had the express authority to act on behalf of the originator
(C) An unauthorized third party who intercepted the originator's transmission
(D) An automated information system programmed by or on behalf of the originator

15. According to Section 13 of the Information Technology Act, 2000, when does the dispatch of an electronic record occur, unless otherwise agreed between the originator and the addressee?

Downloaded from www.pdf.tube

36. (D) Every contact with a digital system leaves digital traces and carries digital traces away
Locard's Exchange Principle, foundational to forensic science, dictates that physical contact between two objects transfers material between them. In digital forensics, this principle manifests whenever a user interacts with a digital system. Opening files, connecting to networks, or sending messages transfers data artifacts onto the system while simultaneously recording environmental parameters, leaving demonstrable digital trails behind.

37. (B) Cached thumbnails of viewed media files
Social networking mobile applications maintain local cache directories to optimize bandwidth consumption and user interface rendering speeds. When users scroll through photo feeds or user profiles, applications automatically downscale and download image fragments as thumbnail graphics stored locally on the device storage, allowing forensic investigators to reconstruct viewed online media despite user profile logouts.

38. (D) I, II and III
Email architectures rely on specific protocols tailored for message distribution and management. Simple Mail Transfer Protocol handles outbound message transport between servers. Post Office Protocol version 3 downloads messages directly to client storage, deleting server copies by default. Internet Message Access Protocol provides bi-directional synchronization between client devices and servers, allowing multi-device mailbox access simultaneously.

39. (D) iCloud
Apple provides cloud storage and backup synchronization across its ecosystem through the iCloud service infrastructure. When enabled on iOS devices, automated cloud backups upload system configurations, user account settings, application databases, iMessage histories, photos, and device metadata directly to Apple iCloud servers, providing digital investigators with remote extraction targets during mobile investigations.

40. (A) Device-extracted authentication token
Modern cloud service providers utilize persistent authentication tokens, such as OAuth tokens, to maintain continuous login sessions on registered mobile devices. Forensic extraction tools can harvest these encrypted authentication tokens directly from device physical storage or keychain databases, allowing investigators to authenticate against cloud service infrastructure and download cloud backups without requiring user passwords.

41. (B) UFED (Universal Forensic Extraction Device)
The Universal Forensic Extraction Device, developed by Israel-based digital intelligence firm Cellebrite, stands as an industry-standard hardware and software solution for mobile forensics. UFED provides law enforcement agencies worldwide with hardware connectivity, bootloader bypass capabilities, physical extraction modules, and analytical software to decode digital evidence across thousands of mobile phone models.

42. (B) Extracting and analyzing digital evidence from mobile devices and smartwatches
XRY is a commercial mobile forensic software solution created by Micro Systemation AB (MSAB) designed specifically to perform logical, file system, and physical data extractions. The platform extracts, decodes, and analyzes stored digital artifacts across mobile phones, tablets, smartwatches, and SIM cards while maintaining strict cryptographic data integrity for judicial submission.

43. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Physical acquisition extracts a direct, complete bit-stream duplicate of all storage sectors within a flash memory module. Because it captures raw storage structures, physical extraction encompasses unallocated space, slack space, deleted database journals, and orphaned file clusters. Consequently, this method yields significantly higher volumes of recoverable deleted artifacts than OS-dependent logical acquisitions.

NODIA

44. (C) Mail Transfer Agent (MTA)
In internet email architecture, a Mail Transfer Agent is server software responsible for routing, transferring, and delivering email communications between host servers using the Simple Mail Transfer Protocol. When an outgoing message is received from a client, the MTA queries DNS records for the destination domain and handles inter-server message exchange across the internet network.

45. (B) Port 25
Transmission Control Protocol port 25 serves as the traditional, default networking port designated by IETF standards for Simple Mail Transfer Protocol communications. Mail Transfer Agents utilize Port 25 to establish plain text or opportunistic TLS connections when transferring outgoing email messages across intermediate internet mail servers, maintaining core routing interoperability throughout global telecommunication systems.

46. (C) To provide the user interface for composing, reading, and managing email communications
A Mail User Agent, commonly known as an email client software application, provides the local graphical or command-line interface that enables human end-users to interact with electronic mail services. MUA applications facilitate composing, reading, organizing, and filing messages before transferring outgoing communications to a designated Mail Transfer Agent via standard protocol mechanisms.

47. (B) The Header and the Body
Electronic mail messages standardized under RFC 5322 strictly divide content into two distinct components: the header and the body. The header section contains structured technical metadata detailing message origin, intermediate routing hops, sender, recipient, timestamp, and subject lines, whereas the body section holds the actual message payload, text content, and attached files.

48. (D) P-4, Q-1, R-3, S-2
Web browsers record user navigation artifacts within specific local storage files. Google Chrome maintains user web history in an SQLite database titled `History`. Mozilla Firefox stores history, bookmarks, and downloads in `places.sqlite`. Legacy Internet Explorer versions utilized proprietary binary `Index.dat` files. Apple Safari manages browsing records within an SQLite file named `History.db`.

49. (A) Received header lines
The Received header lines added sequentially by every participating Mail Transfer Agent supply the most dependable chronological audit trail for tracing an email. Because each handling server prepends its own Received field containing domain names, IP addresses, and exact UTC timestamps, forensic analysts can read these entries bottom-to-top to reconstruct transmission paths reliably.

50. (D) I, II, III, and IV
All four statements accurately outline fundamental email header characteristics. Message-ID provides a globally unique string assigned by the generating server. Received headers record every server hop in the transmission chain, and reading them bottom-to-top reveals chronological routing from origin to destination. Return-Path designates the exact mail address to receive bounce notifications upon delivery failure.

51. (A) X-Originating-IP
The X-Originating-IP header field is a non-standard HTTP header added by several webmail and commercial mail service providers to capture the public IP address of the client device that composed and submitted the email. Forensic examiners inspect this specific header line to identify the actual originating internet connection, bypassing intermediate webmail proxy infrastructure.

52. (D) Email header spoofing
Email header spoofing involves forging email headers so that a message appears to originate from a legitimate sender or trusted domain rather than its true source. Because basic Simple Mail Transfer Protocol lacks built-in authentication mechanisms, malicious actors can easily manipulate header fields such as From and Reply-To to deceive recipients during phishing and social engineering campaigns.

53. (B) SPF Record
Sender Policy Framework is a domain name system authentication record that specifies which mail servers or IP addresses are authorized to send outbound emails on behalf of a given domain. Receiving mail servers query SPF records to verify whether incoming messages originated from authorized sending infrastructure, effectively mitigating email spoofing and phishing attempts.

54. (C) Whaling
Whaling is a specialized form of spear phishing targeting high-profile corporate executives, politicians, or senior organizational leaders. Attackers craft highly tailored messages containing business context or legal threats

Click Here to Buy book on Amazon

designed to deceive executives into authorizing wire transfers, releasing sensitive employee records, or surrendering privileged corporate credentials, distinguishing it from broad automated phishing campaigns.

55. (A) MUA → MTA → MDA → MUA
The standard email delivery lifecycle begins when a user composes a message in a Mail User Agent, which transmits it to a Mail Transfer Agent. The originating MTA routes the email across internet infrastructure to the recipient's MTA, which forwards it to a Mail Delivery Agent to store in the mailbox. Finally, the recipient's MUA retrieves the message.

56. (A) OST (Offline Storage Table)
An Offline Storage Table (.ost) file is a proprietary container format created by Microsoft Outlook when configured with Cached Exchange Mode, Office 365, or IMAP accounts. OST files maintain local, synchronized offline duplicates of mailbox data, messages, calendars, and contacts stored on remote mail servers, enabling users to read and draft emails without an active network connection.

57. (B) Personal Storage Table
The acronym PST stands for Personal Storage Table, which represents a proprietary file format utilized by Microsoft Outlook to store archived email messages, contacts, tasks, journal entries, and calendar items locally on personal computers. PST files allow users to maintain offline mail backups, transfer email repositories between machines, and manage storage quotas independently of network mail servers.

58. (B) MBOX
MBOX is a generic file format widely adopted across Unix-based systems and desktop email clients such as Mozilla Thunderbird to store collections of electronic mail. The format concatenates entire mailbox folders into a single plain-text file, where individual messages are formatted under RFC 822/5322 specifications and separated by a distinct From header line preceding each message block.

59. (A) Browser cache and virtual system memory files
When users interact with webmail services through web browsers without utilizing desktop email clients, message text is not saved as standalone local mailbox databases. Instead, webmail remnants exist as temporary internet cache artifacts, unallocated disk sectors, pagefiles, or active system memory (RAM). Forensic analysis of these volatile structures frequently yields text fragments, session keys, and draft records.

60. (C) P-2, Q-1, R-4, S-3
Major digital forensic solutions are developed by specialized vendors. UFED is produced by Cellebrite. XRY is developed by MSAB (Micro Systemation AB). Oxygen Forensic Detective is created by Oxygen Forensics. Axiom is manufactured by Magnet Forensics. Mapping these tools to their respective vendors yields the correct sequence P-2, Q-1, R-4, and S-3.

61. (D) Temporarily saving web page assets on the local drive to accelerate future loading times
The primary function of a web browser cache is to optimize network efficiency and speed up web browsing. By locally saving static web page elements—including images, cascading style sheets, scripts, and media files—the browser eliminates the necessity of downloading identical assets upon subsequent visits, creating a rich local forensic record of visited web content.

62. (D) I, II and III
All three statements regarding browser artifacts are factual. Browser caches store temporary files to accelerate web page loading speeds. Cookies represent small text files stored by web servers to maintain user sessions, login status, and preference settings. Autofill data retains user inputs from web forms, preserving valuable forensic information including contact names, addresses, and usernames.

NODIA

63. (B) Cookies
Cookies are small text data blocks created by web servers and stored locally on a client computer by the web browser. They track user session identifiers, browsing preferences, shopping cart contents, and authentication credentials. Examining client cookie databases allows forensic investigators to establish user account activity, site visits, and authentication timestamps across web services.

64. (D) A site intentionally saved by the user for future reference, showing interest
Browser bookmarks or favorites represent deliberate user actions to record and organize specific Uniform Resource Locators for future access. In digital forensic investigations, bookmarked websites provide crucial intent-based evidence, indicating specific user interest, deliberate knowledge, or affinity toward particular web resources, online services, or restricted web domains, unlike automatically generated cache files.

65. (A) WebCacheV01.dat
In modern Microsoft Windows operating systems, Internet Explorer and Microsoft Edge manage browser cache metadata, browsing history, download records, and cookies within an Extensible Storage Engine database file titled `WebCacheV01.dat`. Located within user profile subdirectories, analyzing this ESE database provides investigators with a unified chronological index of web navigation activities.

66. (C) The URLs of the websites visited
Private browsing or Incognito modes instruct web browsers to prevent writing browsing session histories, cookies, or form inputs to persistent database files on the hard drive. Consequently, when an incognito session terminates, visited website URLs are excluded from the main history database, though downloaded files and added bookmarks remain saved on the local file system.

67. (A) In the local DNS resolver cache and active RAM
Although private browsing prevents persistent disk storage of history entries, network domain lookups generated during the session are cached in volatile memory by the operating system's DNS resolver service. Forensic tools or command-line utilities querying the live DNS cache and active RAM before rebooting can recover domain names visited during private browsing sessions.

68. (D) Assertion (A) is false but Reason (R) is true.
Private browsing modes do not eliminate all digital traces of web activity on a local machine, rendering the assertion false. Web interactions during private sessions rely on volatile RAM and the operating system's local DNS resolver cache to perform domain queries, allowing digital investigators to recover visited domains prior to system shutdown or memory flushing.

69. (B) traceroute command
The traceroute command-line utility (known as `tracert` in Windows operating environments) identifies the specific path internet protocol packets traverse from a local source host to a target IP address or domain. By measuring hop delays across intermediate routers using ICMP or UDP packets with incrementing Time-To-Live values, investigators map intermediate network nodes.

70. (C) Identifies country, region, and ISP, requiring ISP subscriber logs for exact address
IP geolocation queries publicly accessible databases to map an Internet Protocol address to general geographic boundaries, identifying the associated country, region, city, and Internet Service Provider. However, because public IP databases cannot pinpoint precise physical street addresses, establishing specific user identity or exact physical location requires obtaining subscriber assignment logs directly from the ISP.

71. (A) 3, 1, 2, 4
A physical Chip-off forensic extraction requires a strict operational order. Examiners first apply heat to desolder the target flash memory chip from the smartphone motherboard. Next, solder pads and contact pins are cleaned or reballed. The chip is then inserted into a specialized hardware programmer to read raw memory binary, followed by logical reconstruction using software.

72. (A) Exact timestamp of the dynamic IP lease assignment
Internet Service Providers assign dynamic IP addresses to subscribers from shared address pools, frequently changing address assignments over time. To accurately map cyber activity to a physical subscriber, law enforcement agencies must supply both the dynamic IP address and the precise timestamp of the activity. This enables ISPs to query dynamic DHCP assignment logs successfully.

73. (B) Common Log Format (CLF)
The Common Log Format is a standardized text file format utilized by Apache and other web server architectures to produce client transaction logs. A standard CLF record records client IP

Downloaded from www.pdf.tube

addresses, client identifiers, HTTP request timestamps, request methods, requested URI paths, HTTP protocol versions, HTTP response status codes, and transferred byte counts in a structured sequence.

74. (B) Platforms strip EXIF metadata during image compression for privacy and storage optimization
Social media platforms like Facebook and WhatsApp automatically process user-uploaded photographs through image processing pipelines. During server-side media compression and optimization, platforms strip Exchangeable Image File Format metadata—including GPS coordinates, camera model specifications, and exposure timestamps—to protect user privacy, reduce server storage overhead, and optimize network bandwidth during media delivery.

75. (A) I, II, and IV
In Voice over IP operations, Session Initiation Protocol controls call establishment, maintenance, and termination, while Real-time Transport Protocol delivers actual streaming audio and video payloads, rendering statements I and II incorrect. Furthermore, unencrypted VoIP streams remain vulnerable to packet sniffing, making IV false. WebRTC enables browser-based media communication without plugins, rendering III correct.

76. (C) SIP (Session Initiation Protocol)
Session Initiation Protocol is an application-layer signaling protocol defined by RFC 3261 used for initiating, maintaining, modifying, and terminating real-time multimedia sessions over IP networks. In VoIP systems, SIP handles caller registration, address resolution, user location, call setup, and session teardown, working alongside protocols like RTP that transport real-time voice media.

77. (D) Modern VoIP session traffic is encrypted using security protocols like SRTP
Analyzing captured VoIP stream traffic presents significant technical challenges when media streams are encrypted using protocols such as Secure Real-time Transport Protocol (SRTP) or Transport Layer Security (TLS). While packet capture tools record encrypted UDP payloads, reconstructing or listening to call audio requires obtaining active encryption keys, session certificates, or pre-shared secrets.

78. (C) Surface Web is indexed, Deep Web is unindexed web content, and Dark Web requires routing software like Tor
The internet architecture is categorized into three structural layers based on indexation and accessibility. The Surface Web comprises publicly indexed pages searchable via standard search engines. The Deep Web includes unindexed content such as password-protected databases, dynamic pages, and private portals. The Dark Web constitutes an encrypted overlay subset requiring specialized anonymity software like Tor.

79. (B) P-3, Q-1, R-2, S-4
Email storage formats serve specific technical storage functions. PST files store local Outlook personal archives. OST files maintain offline synchronized tables for Exchange/ Outlook configurations. EML files represent a standardized plain-text format holding single raw email messages. MBOX files concatenate multiple email messages into a unified plain-text file, yielding the pairing sequence P-3, Q-1, R-2, and S-4.

NODIA

80. (D) The Tor Network
The Onion Router (Tor) network represents the primary technology infrastructure used to host and access hidden services on the Dark Web. By implementing multi-layered onion routing, Tor encrypts user web traffic and routes it sequentially through a global network of volunteer relays, masking client IP addresses and providing anonymous communication channels for users and web servers.

81. (A) Exit Node
In Tor network architecture, the exit node functions as the final relay point in an encrypted multi-hop virtual circuit. The exit node decrypts the innermost layer of onion encryption and forwards unencrypted traffic to its ultimate destination server on the clear web, serving as the public source IP address visible to receiving destination systems.

82. (A) I and II only
Accessing Dark Web content requires specialized routing platforms like Tor, which utilizes multi-layer onion routing to strip encryption layers at sequential intermediate relays. However, cryptocurrencies like Bitcoin are frequently utilized for commercial transactions on darknet

marketplaces despite public blockchain ledger visibility, making statements I and II true while statement III is inaccurate.

83. (A) Deletion removes pointer references, leaving data in unallocated space until overwritten
When a user deletes a text message from mobile storage, the file system removes database index pointers without instantly erasing raw data bytes. The physical storage space containing the message text is marked as unallocated, allowing forensic tools to extract bit-stream images and recover deleted message fragments before background write operations overwrite those sectors.

84. (D) /data/data/
In Android file system architecture, user application data, configuration files, shared preferences, and SQLite databases reside within the protected `/data/data/` directory. Each installed application maintains a private subdirectory under this path corresponding to its package name, where contact logs, call records, text databases, and user account configurations are stored securely.

85. (B) HTTP status code indicating a successful request
HTTP server access logs record standard numerical status codes returned by web servers to indicate request processing outcomes. The status code "200" defined in RFC standards signifies "200 OK," confirming that the server successfully received, understood, and processed the client's request, subsequently delivering the requested web page resource or file payload to the client.

86. (C) Section 66A
Section 66A of the Information Technology Act, 2000 penalised sending offensive or menacing messages through electronic communication services. In the landmark 2015 judgment *Shreya Singhal v. Union of India*, the Supreme Court of India struck down Section 66A entirely, ruling that its vague phrasing violated the fundamental right to freedom of speech guaranteed under Article 19(1)(a).

87. (D) Issuing a legal notice under Section 91 CrPC / Section 94 BNSS to the service provider
Under the Indian criminal procedure framework, investigating officers issue formal legal requisitions under Section 91 of the Code of Criminal Procedure (or Section 94 of the Bharatiya Nagarik Suraksha Sanhita) to order service providers to produce documents, electronic subscriber logs, or call records necessary for establishing origin during criminal investigations.

88. (D) Assertion (A) is false but Reason (R) is true.
JTAG physical extraction does not involve unsoldering memory chips from printed circuit boards; rather, it connects directly to standardized test access points on the motherboard to communicate with internal microprocessors. Physical chip desoldering defines the Chip-off technique, making Assertion A false while Reason R correctly describes non-destructive JTAG access protocols.

89. (B) Systematically attempting all passcode combinations until the correct key is found
A brute-force attack in mobile forensics involves systematically generating and testing all possible numerical PINs, alphanumeric passwords, or graphical patterns against a locked device until the valid combination is identified. Specialized forensic hardware devices employ automated brute-force routines while bypassing delay timers and anti-tamper security mechanisms enforced by device software.

90. (B) Oracle
Android, iOS, and HarmonyOS represent specialized mobile operating systems engineered to run smartphone and mobile hardware architectures. Conversely, Oracle is an enterprise database, cloud infrastructure, and software platform vendor, not a mobile operating system. This distinction isolates Oracle as the technical odd one out among the listed mobile operating system options.

www.nodia.in

Click Here to Buy book on Flipkart

CHAPTER 34 34
Basics Of The Information Technology Act

1. Which international model law primarily served as the basis for the enactment of the Information Technology Act, 2000 in India?
(A) WIPO Copyright Treaty, 1996
(B) UNCITRAL Model Law on Electronic Commerce, 1996
(C) Geneva Convention on Cybercrime, 1998
(D) ITU International Telecommunication Regulations, 1999

2. Under Section 1 of the Information Technology Act, 2000, which of the following statements accurately describes the territorial application of the Act?
(A) It applies only to offences committed within the physical boundaries of India.
(B) It applies only to Indian citizens, regardless of where the offence is committed or which computer is used.
(C) It applies universally to all cyber offences committed globally, provided the victim is an Indian citizen.
(D) It applies to any offence or contravention committed outside India by any person, provided the act involves a computer, computer system, or computer network located in India.

3. Under the Information Technology Act, 2000, which section explicitly defines the term "Computer"?
(A) Section 2(1)(g)
(B) Section 2(1)(i)
(C) Section 2(1)(j)
(D) Section 2(1)(k)

4. Consider the following statements regarding the Information Technology (Amendment) Act, 2008:
I. It introduced the concept of "Electronic Signature" to make the Act technologically neutral.
II. It introduced Section 66A to penalize sending offensive messages through communication services.
III. It established the statutory framework for the Indian Computer Emergency Response Team (CERT-In).
Which combination of the above statements is correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

5. As per the definitions in the Information Technology Act, 2000, "Data" means a representation of information, knowledge, facts, concepts or instructions which are being prepared or have been prepared in a formalized manner, and is intended to be processed in a:
(A) Computer system or computer network
(B) Telecommunication exchange mechanism
(C) Print media or paper archive format
(D) Traditional ledger or manual system

6. How is an "Electronic Record" defined under Section 2(1)(t) of the Information Technology Act, 2000?
(A) Any digitally signed PDF or electronic document verified and issued by a recognized Certifying Authority.
(B) A backup copy of proprietary computer source code stored and maintained securely on a magnetic drive.
(C) Any traditional printed document that has been optically scanned, converted, and securely archived.
(D) Data, record, generated data, image or sound stored, received or sent in electronic form or microfiche.

7. According to the Information Technology Act, 2000, an "Asymmetric Crypto System" utilizes which of the following mechanisms to create a secure key pair?
(A) A single shared secret key for both encryption and decryption
(B) A public key for encryption and a private key for decryption
(C) Two identical private keys distributed by a Certifying Authority

Downloaded from www.pdf.tube

collection routines, rendering deleted artifacts permanently unrecoverable.

27. (A) I and II only
Logical acquisition captures files presented by the operating system interface, whereas physical acquisition captures a bit-level binary copy of raw flash storage, including unallocated memory. However, file system acquisition can access hidden application databases, and physical acquisition is typically complex, slow, and often requires privileged device access, making statements I and II accurate while III and IV are incorrect.

28. (C) Property List (.plist) configuration files
Apple iOS applications and system services heavily rely on Property List (.plist) files to store persistent user settings, application preferences, device configurations, and system metadata. Structured as structured XML or binary formatted documents, plist files contain critical forensic evidence, including network histories, account information, application state parameters, and recent execution timestamps across Apple mobile devices.

29. (D) Android Debug Bridge (ADB)
The Android Debug Bridge is a versatile command-line interface tool provided in the Android Software Development Kit. ADB facilitates direct communication between a host computer and a connected Android device over USB or network interfaces. Forensic tools leverage ADB commands to perform logical extractions, query system information, push diagnostic packages, and access application data directories when USB debugging is enabled.

30. (C) BFU (Before First Unlock)
Before First Unlock defines the operational state of an iOS device after being powered on but prior to the user entering the correct passcode for the first time. In BFU state, file system contents remain protected by hardware-backed hardware encryption keys managed by the Secure Enclave, severely limiting the extent of data accessible through digital extraction techniques.

31. (B) Analyzing oily finger residues on the glass screen to infer pattern locks
A smudge attack represents a physical side-channel vulnerability where an adversary inspects or photographs oily residues left by human fingers on a mobile touchscreen surface. By analyzing lighting reflections across smudge geometry, an attacker can infer unlock patterns or graphical PIN sequences previously entered by the user, providing an avenue to compromise device security non-invasively.

32. (A) Photograph the screen, Isolate from networks, Package in Faraday bag, Transport to laboratory
Proper forensic protocol demands documenting visible evidence before modifying hardware states. Upon discovering an active smartphone, investigators first photograph display contents to capture volatile on-screen information. Next, network features are disabled or isolated to block incoming signals. The device is then sealed inside a Faraday bag and safely transported to a controlled laboratory environment for extraction.

33. (A) SQLite Database
The Android operating system extensively utilizes embedded SQLite database structures for lightweight, local relational data storage across system services and mobile applications. Short message service communications, multimedia messaging records, contact directories, and call logs are maintained within designated `.db` or `.sqlite` database files, enabling fast structured querying and transactional data management on portable mobile hardware.

34. (C) Write-Ahead Log (WAL) transaction files
SQLite engines operating in Write-Ahead Log mode write structural data modifications to a secondary `-wal` transaction file prior to committing changes to the primary database file. Because deleted records and recent database updates remain in the WAL file until a checkpoint process consolidates them, these auxiliary files represent high-value forensic artifacts for recovering recently deleted entries.

35. (A) msgstore.db
On Android devices, WhatsApp manages user messaging records, timestamps, contact identities, and conversation threads within an internal SQLite file named `msgstore.db`. While encrypted backup copies stored on external storage carry extensions like `.db.crypt14`, the active, unencrypted operational database situated in the protected application data path `/data/data/com.whatsapp/databases/` is identified specifically as `msgstore.db`.

NODIA

(A) When it is read by the addressee
(B) When the originator clicks the send button, regardless of network connection
(C) When the addressee's server sends an automated read receipt
(D) When it enters a computer resource outside the control of the originator

16. Section 14 of the Information Technology Act, 2000 provides that an electronic record shall be deemed to be a secure electronic record if:
(A) It is encrypted using any standard commercial or open-source cryptographic software package.
(B) It has been authenticated using a valid digital signature certificate issued by a recognized Certifying Authority.
(C) The prescribed security procedure has been applied to it from a specified point of time to verification.
(D) It is stored and maintained continuously on a secure government-owned computer network infrastructure.

17. The Controller of Certifying Authorities (CCA) is appointed by the Central Government under which section of the Information Technology Act, 2000?
(A) Section 15
(B) Section 17
(C) Section 21
(D) Section 25

18. Which of the following is NOT a function of the Controller of Certifying Authorities under the Information Technology Act, 2000?
(A) Exercising supervision over the activities of the Certifying Authorities
(B) Laying down the standards to be maintained by the Certifying Authorities
(C) Resolving conflicts of interest between the Certifying Authorities and subscribers
(D) Issuing Digital Signature Certificates directly to individual citizens

19. What is the maximum validity period of a Digital Signature Certificate (DSC) typically issued by a Certifying Authority in India, as per the established guidelines?
(A) 1 year
(B) 3 years
(C) 5 years
(D) 10 years

20. Arrange the following steps in the correct sequence for obtaining and using a Digital Signature Certificate (DSC) under the Information Technology Act framework:
1. Generation of the key pair (Public and Private keys)
2. Submission of application and identity proof to a Certifying Authority
3. Issuance of the Digital Signature Certificate linking the public key to the subscriber
4. Affixing the digital signature to an electronic record using the private key

Which of the following represents the correct sequence?
(A) 2, 1, 3, 4
(B) 1, 2, 3, 4
(C) 2, 3, 1, 4
(D) 1, 3, 2, 4

21. Which authority is responsible for issuing a licence to issue Electronic Signature Certificates to a Certifying Authority?
(A) Controller of Certifying Authorities (CCA)
(B) Ministry of Home Affairs
(C) Indian Computer Emergency Response Team (CERT-In)
(D) Cyber Appellate Tribunal

22. Match the following authorities/entities under the Information Technology Act, 2000 (List I) with their corresponding roles/functions (List II):
List I: (Authority / Entity)
P. Controller of Certifying Authorities
Q. Certifying Authority
R. Subscriber
S. Intermediary
List II: (Role / Function)
1. Generates the key pair and uses the digital signature
2. Issues the Digital Signature Certificate
3. Receives, stores, or transmits electronic records on behalf of another person
4. Maintains the National Repository of Digital Certificates
(A) P-4, Q-2, R-1, S-3
(B) P-2, Q-4, R-3, S-1
(C) P-4, Q-2, R-3, S-1
(D) P-2, Q-4, R-1, S-3

23. Under Section 40 of the Information Technology Act, 2000, whose primary duty is it to exercise reasonable care to retain control of the private

Click Here to Buy book on Amazon

through the use of satellite, microwave, terrestrial line or other communication media.
(D) Both (A) and (C) are part of the statutory definition.

67. Which term is used in the Information Technology Act, 2000 to denote the procedure applied to an electronic record to verify that it has remained unaltered since a specific point in time?
(A) Secure Electronic Record Procedure
(B) Asymmetric Cryptographic Verification
(C) Hash Function Data Encryption System
(D) Digital Source Authentication Procedure

68. Under Section 80 of the Information Technology Act, 2000, which officer has the power to enter any public place and search and arrest without warrant any person who is reasonably suspected of having committed an offence under the Act?
(A) Any police officer not below the rank of Deputy Superintendent of Police
(B) Any police officer not below the rank of Sub-Inspector
(C) Any police officer not below the rank of Inspector
(D) Only officers attached to a designated Cyber Crime Police Station

69. When investigating a cybercrime scene involving a server running critical financial data, a forensic science assistant must prioritize capturing volatile data before pulling the plug. Volatile data is primarily stored in:
(A) Random Access Memory (RAM)
(B) Hard Disk Drive (HDD)
(C) Solid State Drive (SSD)
(D) Read-Only Memory (ROM)

70. In the context of computer forensics and the Information Technology Act, 2000, a "Hash Value" is often generated for seized electronic evidence. The primary purpose of this hash value is to:
(A) Encrypt the seized digital evidence securely so the suspect or unauthorized parties cannot access or read it.
(B) Compress the forensic disk image to save storage space on law enforcement analysis workstations.
(C) Translate raw binary machine code into human-readable programming language source code for analysis.
(D) Establish the chain of custody and prove the integrity of the data has not been altered since seizure.

71. The National Critical Information Infrastructure Protection Centre (NCIIPC) is established under Section 70A of the Information Technology Act, 2000. NCIIPC functions under the administrative control of which organization?
(A) Indian Computer Emergency Response Team (CERT-In)
(B) National Technical Research Organisation (NTRO)
(C) Ministry of Electronics and Information Technology (MeitY)
(D) Directorate of Forensic Science Services (DFSS)

NODIA

72. Read the following statements regarding the territorial jurisdiction of the Information Technology Act, 2000 and select the correct option:
Assertion (A): The Information Technology Act, 2000 has extra-territorial jurisdiction.
Reason (R): Section 75 states that the Act applies to any offence or contravention committed outside India by any person if the act involves a computer, computer system or computer network located in India.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

73. Consider the following grounds under which the Central Government can issue blocking orders under Section 69A of the Information Technology Act, 2000:
I. Interest of sovereignty and integrity of India
II. Defense of India and security of the State
III. Friendly relations with foreign states or public order
IV. Defamation of a corporate entity or political figure
Which combination of the above statements represents the correct statutory grounds?
(A) I, II and III only
(B) I, III and IV only
(C) II, III and IV only
(D) I, II, III and IV

STUDYING FROM PDFs?

THINK AGAIN.

If you are studying only from PDFs,
you are wasting valuable time.

Research shows that learning from

PRINTED BOOKS has up to

4× HIGHER RETENTION

than studying from screens.

PRINT BOOK = BETTER MEMORY

PDF = LOWER RETENTION

Those who study from **PRINTED BOOKS**
move **AHEAD.**

Others are left **BEHIND**
in competition.

In competitive exams,
being average is not enough.

STAY ONE STEP AHEAD.

II. Section 66 provides for criminal liability for the exact same acts listed in Section 43, provided they are done dishonestly or fraudulently.
III. A person cannot be held liable under both Section 43 and Section 66 simultaneously.

Which combination of the above statements is correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

31. Under Section 66B of the Information Technology Act, 2000, whoever dishonestly receives or retains any stolen computer resource or communication device, knowing it to be stolen, shall be punished with imprisonment up to:
(A) 1 year
(B) 2 years
(C) 3 years
(D) 5 years

32. Which section of the Information Technology Act, 2000 penalizes the offence of "Identity Theft," which involves fraudulently or dishonestly making use of the electronic signature, password, or any other unique identification feature of any other person?
(A) Section 66B
(B) Section 66C
(C) Section 66D
(D) Section 66E

33. A cybercriminal creates a fake social media profile using the name and photographs of a prominent public figure and uses this profile to solicit funds from unsuspecting users. Under the Information Technology Act, 2000, this act primarily constitutes an offence under:
(A) Section 65 (Tampering with computer source documents and records)
(B) Section 66B (Dishonestly receiving stolen computer resource or device)
(C) Section 66D (Cheating by personation by using computer resource)
(D) Section 66E (Violation of privacy by capturing private images)

34. Section 66E of the Information Technology Act, 2000 penalizes the violation of privacy. This section specifically addresses the intentional capturing, publishing, or transmitting of the image of a private area of any person without their consent. What constitutes a "private area" under this section?
(A) Any fully enclosed private space or location such as a personal bedroom or bathroom facility
(B) Any confidential personal data, private photos, or messages stored on a mobile device
(C) Any spatial area located within the secure boundary walls of a private residential property
(D) The naked or undergarment clad genitals, pubic area, buttocks, or female breast

35. Consider the following statements regarding Section 66F (Cyber Terrorism) of the Information Technology Act, 2000:
I. It includes acts intended to threaten the unity, integrity, security or sovereignty of India.
II. It covers denying access to authorized personnel to a computer resource.
III. It covers introducing a computer contaminant that causes death or injuries to persons.

Which combination of the above statements is correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

36. What is the punishment prescribed for committing cyber terrorism under Section 66F of the Information Technology Act, 2000?
(A) Imprisonment for a term which may extend to 7 years along with mandatory fine
(B) Rigorous imprisonment for a term up to 10 years and financial penalty
(C) Imprisonment which may extend to imprisonment for life
(D) Death penalty or life imprisonment depending on the severity of the act

37. Consider the following statements regarding Section 67 of the Information Technology Act, 2000, which penalizes publishing or transmitting obscene material in electronic form:
I. It applies to any material which is lascivious or appeals to the prurient interest.
II. It applies if its effect is such as to tend to deprave and corrupt persons who are likely to read, see or hear the matter.
III. The maximum punishment for a first conviction is 3 years imprisonment and a

Downloaded from www.pdf.tube

any public place without a warrant if he reasonably suspects an offence under this Act has been committed.

III. All offences under the IT Act are strictly non-bailable.

Which combination of the above statements is correct?

(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

82. Arrange the steps typically followed by a Forensic Science Laboratory (FSL) when processing a seized mobile phone suspected to be used in an offence under Section 66D (Cheating by personation) of the Information Technology Act, 2000:

1. Generating a cryptographic hash of the extracted data
2. Isolation of the device from cellular networks (Faraday bag)
3. Physical examination and documentation of the device
4. Logical or physical extraction of data using forensic tools

Which of the following represents the correct sequence?

(A) 2, 3, 4, 1
(B) 3, 2, 4, 1
(C) 3, 4, 1, 2
(D) 2, 4, 3, 1

83. Match the following terms defined under the Information Technology Act, 2000 (List I) with their defining elements (List II):

List I: (Term)

P. Cyber Cafe
Q. Computer Contaminant
R. Electronic Gazette
S. Key Pair

List II: (Defining Element)

1. Set of instructions designed to modify, destroy, record or transmit data within a computer
2. Facility from where access to the internet is offered by any person in the ordinary course of business
3. The Official Gazette published in electronic form
4. An asymmetric crypto system containing a private key and its mathematically related public key

(A) P-2, Q-1, R-3, S-4
(B) P-1, Q-2, R-4, S-3
(C) P-2, Q-1, R-4, S-3
(D) P-3, Q-1, R-2, S-4

84. Which provision was introduced into penal law via the Information Technology Act, 2000 to define the offence of making a false electronic record?

(A) Cyber defamation
(B) Electronic criminal trespass
(C) Forgery of electronic record
(D) Digital extortion

85. The National Cyber Security Policy of India, which aims to protect information and information infrastructure in cyberspace, was published in the year:

(A) 2000
(B) 2008
(C) 2013
(D) 2020

NODIA

86. Which section of the Information Technology Act, 2000 deals with the penalty for misrepresentation or suppression of a material fact to the Controller or the Certifying Authority to obtain a license or Digital Signature Certificate?

(A) Section 71
(B) Section 72
(C) Section 73
(D) Section 74

87. An individual publishes a false electronic signature certificate knowing it to be false. Under which section of the Information Technology Act, 2000 is this act penalized?

(A) Section 65
(B) Section 66
(C) Section 73
(D) Section 79

88. In the context of electronic evidence admissibility under Section 63 of the Bharatiya Sakshya Adhiniyam, 2023 / Section 65B of the Indian Evidence Act, 1872, who is statutorily authorized to sign the required certificate?

(A) Any police officer or designated law enforcement official actively involved in conducting the formal criminal investigation.
(B) The Judicial Magistrate or Sessions Judge having appropriate jurisdiction and taking formal cognizance of the criminal trial.
(C) A person occupying a responsible official position in relation to the operation of the

punished with imprisonment of either description for a term which may extend to:
(A) 3 years
(B) 5 years
(C) 7 years
(D) 10 years

46. Match the following offences under the Information Technology Act, 2000 (List I) with their corresponding Sections (List II):
List I: (Offence)
P. Dishonestly receiving stolen computer resource
Q. Identity theft
R. Cheating by personation by using computer resource
S. Violation of privacy
List II: (Section)
1. Section 66C
2. Section 66E
3. Section 66B
4. Section 66D
(A) P-3, Q-1, R-4, S-2
(B) P-1, Q-3, R-2, S-4
(C) P-4, Q-2, R-1, S-3
(D) P-3, Q-4, R-1, S-2

47. Section 72 of the Information Technology Act, 2000 penalizes the breach of confidentiality and privacy. It specifically applies to:
(A) Any individual who intentionally accesses, inspects, or browses another person's unlocked smartphone without explicit authorization.
(B) Any commercial network intermediary that temporarily stores or transmits encrypted personal data packets across servers.
(C) Any active social media user who creates, forwards, or shares unverified fake news or misleading posts across online networks.
(D) Any person who, under powers conferred by the Act, secures access to an electronic record and discloses it without consent.

48. Section 72A of the Information Technology Act, 2000 deals with the punishment for disclosure of information in breach of lawful contract. It primarily targets:
(A) Government officials or public servants who intentionally leak classified state security secrets to unauthorized individuals.
(B) Intermediaries or network service providers that fail to comply with executive orders to block specific public websites.
(C) Persons who disclose personal information obtained under a lawful contract with intent to cause wrongful loss or gain.
(D) Certifying Authorities that abruptly revoke digital signature certificates of subscribers without prior notice or cause.

49. Read the following statements regarding the liability of intermediaries under the Information Technology Act, 2000 and select the correct option:
Assertion (A): Intermediaries like social media platforms and Internet Service Providers are absolutely immune from all legal liabilities for third-party information hosted by them under Section 79 of the IT Act.
Reason (R): Section 79 provides a "safe harbour" to intermediaries, provided they observe due diligence and do not initiate the transmission, select the receiver, or modify the information.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

50. Under Section 79 of the Information Technology Act, 2000, the safe harbour protection granted to an intermediary shall NOT apply if:
(A) The intermediary provides data storage services for an enterprise.
(B) The intermediary uses automated filtering tools to remove malware.
(C) The intermediary complies with the government's order to decrypt a message.
(D) The intermediary conspired or abetted in the commission of the unlawful act.

51. Under the Information Technology Act, 2000, an Adjudicating Officer appointed under Section 46 has the power to hold an inquiry and adjudicate matters where a person has committed a contravention of any of the provisions of the Act or rules. The Adjudicating Officer must possess the experience and qualifications equivalent to a:
(A) Director to the Government of India or an equivalent officer of a State Government
(B) District Judge serving in the State Judicial Service with five years of standing
(C) High Court Judge or a senior judicial officer eligible for elevation to the Bench
(D) Superintendent of Police heading an IPS cadre or State Cyber Crime Investigation

Click Here to Buy book on Flipkart

key corresponding to the public key listed in their Digital Signature Certificate?
(A) The Certifying Authority
(B) The Subscriber
(C) The Controller of Certifying Authorities
(D) The Intermediary

24. What is the statutory penalty prescribed under Section 43 of the Information Technology Act, 2000 for unauthorized access, downloading data, or introducing a computer virus into a computer system or network?
(A) Imprisonment up to 3 years or fine up to Rs. 5 lakh, or both together with confiscation of assets
(B) Imprisonment up to 1 year or fine up to Rs. 1 lakh, along with suspension of user credentials
(C) Liability to pay damages by way of compensation to the person so affected by the contravention
(D) Mandatory confiscation of the computer system used, along with permanent revocation of license

25. Section 43A of the Information Technology Act, 2000 provides for compensation for failure to protect data. This section specifically applies to:
(A) Any individual user operating a personal smartphone or computer resource
(B) Government departments dealing with classified or sensitive national security information
(C) Certifying Authorities managing public key infrastructure and digital certificate repositories
(D) Body corporates possessing, dealing, or handling sensitive personal data or information

26. Under the Information Technology (Reasonable Security Practices and Procedures and Sensitive Personal Data or Information) Rules, 2011 framed under Section 43A, which of the following is NOT classified as "Sensitive Personal Data or Information"?
(A) Information publicly available or accessible under the Right to Information Act, 2005
(B) User authentication credentials, security passcodes, and system passwords
(C) Financial account information including bank details, credit, or debit card numbers
(D) Biometric data records including facial patterns, fingerprints, and iris scans

NODIA

27. Section 65 of the Information Technology Act, 2000 penalizes tampering with computer source documents. Which of the following conditions must be met for this offence to be attracted?
(A) The source code must be made freely available to the general public under an open-source license.
(B) The computer source code must be required to be kept or maintained by law for the time being in force.
(C) The tampering act must directly result in an assessed direct financial loss of at least Rs. 1 lakh.
(D) The tampering must be intentionally executed by an active employee or contractor of the target firm.

28. What is the maximum punishment prescribed for tampering with computer source documents under Section 65 of the Information Technology Act, 2000?
(A) Imprisonment up to 1 year or fine up to Rs. 1 lakh, or both
(B) Imprisonment up to 2 years or fine up to Rs. 2 lakh, or both
(C) Imprisonment up to 3 years or fine up to Rs. 2 lakh, or both
(D) Imprisonment up to 5 years or fine up to Rs. 5 lakh, or both

29. Read the following statements regarding Section 66 of the Information Technology Act, 2000 and select the correct option:
Assertion (A): The offence of hacking is comprehensively defined and explicitly named as "Hacking" under Section 66 of the Information Technology (Amendment) Act, 2008.
Reason (R): Section 66 deals with computer related offences, stating that if any person, dishonestly or fraudulently, does any act referred to in Section 43, he shall be punishable with imprisonment or fine.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

30. Consider the following statements regarding the overlap between Section 43 and Section 66 of the Information Technology Act, 2000:
I. Section 43 provides for civil liability in the form of compensation.

mandatory pre-condition for admitting secondary evidence of an electronic record?
(A) Anwar P.V. v. P.K. Basheer
(B) Tomaso Bruno v. State of U.P.
(C) Arjun Panditrao Khotkar v. Kailash Kushanrao Gorantyal
(D) Shafi Mohammad v. State of Himachal Pradesh

62. In the 2020 landmark case of Arjun Panditrao Khotkar v. Kailash Kushanrao Gorantyal, the Supreme Court of India clarified the requirement of the Section 65B certificate under the Indian Evidence Act, 1872. What was the key ruling regarding primary evidence?
(A) The certificate is mandatorily required even if the original computer or recording device is produced in court.
(B) The certificate must be duly authenticated and signed by at least two gazetted officers to be legally valid.
(C) The certificate is not required if the original device (primary evidence) itself is produced in court.
(D) The requirement of submitting the certificate is entirely optional and rests on the presiding judge's discretion.

63. Consider the following statements regarding the overlap between the Information Technology Act, 2000 and general penal laws:
I. If an act constitutes an offence under both the IT Act and the general penal law, the offender can be prosecuted under both simultaneously for the same specific ingredients.
II. The Supreme Court in Sharat Babu Digumarti v. Govt of NCT of Delhi ruled that if an offence involves an electronic record, the special provisions of the IT Act will prevail over general provisions of the Indian Penal Code.
III. Section 81 of the IT Act states that its provisions shall have an overriding effect over any other law for the time being in force.
Which combination of the above statements is correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

64. A suspect uses a computer to create a forged electronic record to deceive someone and extract money. This act attracts provisions of the Information Technology Act, 2000 (Section 66C/66D) and general penal laws (cheating/forgery). Based on established legal principles, how are such cases generally registered by investigating officers?
(A) FIR is registered solely under the IT Act since special penal provisions automatically supersede general provisions of the penal code during investigation.
(B) FIR is registered solely under general penal provisions, while specific IT Act sections are introduced only at the stage of trial court proceedings.
(C) FIR is registered under both the IT Act and relevant general penal sections to cover all facets of the crime, subject to judicial framing of charges.
(D) The matter is referred directly to the Cyber Appellate Tribunal for summary administrative proceedings without lodging a police FIR.

NODIA

65. Match the following cybercrimes under the Information Technology Act, 2000 (List I) with the prescribed maximum imprisonment for the first conviction (List II):
List I: (Cybercrime)
P. Tampering with computer source documents (Section 65)
Q. Cyber Terrorism (Section 66F)
R. Publishing obscene material in electronic form (Section 67)
S. Publishing sexually explicit material in electronic form (Section 67A)
List II: (Maximum Imprisonment)
1. 3 years
2. 5 years
3. 7 years
4. Life imprisonment
(A) P-1, Q-4, R-1, S-2
(B) P-1, Q-4, R-1, S-3
(C) P-2, Q-4, R-1, S-2
(D) P-1, Q-3, R-2, S-2

66. Under the Information Technology Act, 2000, what is the statutory definition of "Computer Network"?
(A) The physical interconnection of two or more computers through communication lines.
(B) The software used to manage internet traffic.
(C) The interconnection of one or more computers

Cell

52. What is the correct hierarchical sequence of adjudication and appeals regarding civil contraventions and compensation under the Information Technology Act, 2000?
(A) Adjudicating Officer → High Court → Supreme Court
(B) Adjudicating Officer → Cyber Appellate Tribunal (TDSAT) → High Court → Supreme Court
(C) Cyber Appellate Tribunal (TDSAT) → Adjudicating Officer → High Court
(D) Adjudicating Officer → District Court → High Court

53. Which of the following ranks of police officers is empowered under Section 78 of the Information Technology Act, 2000 to investigate offences punishable under the Act, unless otherwise specified?
(A) Inspector of Police
(B) Sub-Inspector of Police
(C) Assistant Commissioner of Police / Deputy Superintendent of Police
(D) Superintendent of Police

54. According to Section 77B of the Information Technology Act, 2000, offences punishable with imprisonment of three years and above are:
(A) Non-cognizable and bailable
(B) Cognizable and non-bailable
(C) Non-cognizable and non-bailable
(D) Cognizable and bailable

55. What is the full form of CERT-In, the nodal agency established under Section 70B of the Information Technology Act, 2000?
(A) Central Electronic Response Team - India
(B) Indian Computer Emergency Response Team
(C) Cyber Emergency Resolution Team - India
(D) Council for Electronic Record Transmissions - India

56. Consider the following functions:
I. Collection, analysis and dissemination of information on cyber incidents
II. Issuing Digital Signature Certificates to foreign nationals
III. Cyber security emergency measures
IV. Coordination of cyber incident response activities
Which combination of the above statements represents the statutory functions of CERT-In under Section 70B of the Information Technology Act, 2000?
(A) I, II and III only
(B) II, III and IV only
(C) I, III and IV only
(D) I, II, III and IV

57. Which landmark judgment of the Supreme Court of India in 2015 struck down Section 66A of the Information Technology Act, 2000, declaring it unconstitutional and a violation of the freedom of speech and expression under Article 19(1)(a)?
(A) K.S. Puttaswamy v. Union of India
(B) Anwar P.V. v. P.K. Basheer
(C) Navtej Singh Johar v. Union of India
(D) Shreya Singhal v. Union of India

58. The admissibility of electronic records as evidence in Indian courts is primarily governed by which special provision originally inserted by the Information Technology Act, 2000 into the Indian Evidence Act, 1872?
(A) Section 45A
(B) Section 65A and 65B
(C) Section 73A
(D) Section 114A

59. Under the Bharatiya Sakshya Adhiniyam, 2023 (BSA), which section corresponds to the erstwhile Section 65B of the Indian Evidence Act, 1872 concerning the admissibility of electronic records?
(A) Section 59
(B) Section 61
(C) Section 63
(D) Section 65

60. For an electronic record to be deemed admissible as a "document" in a court of law without producing the original computer system, a certificate is mandatory. Under the erstwhile Indian Evidence Act, 1872, this certificate was required under:
(A) Section 65B(1)
(B) Section 65B(2)
(C) Section 65B(3)
(D) Section 65B(4)

61. Which landmark judgment of the Supreme Court of India in 2014 overruled the State (NCT of Delhi) v. Navjot Sandhu case and definitively established that the certificate under Section 65B(4) of the Indian Evidence Act, 1872 is a

Downloaded from www.pdf.tube

74. Read the following statements regarding protected systems under the Information Technology Act, 2000 and select the correct option:
Assertion (A): The appropriate Government may, by notification in the Official Gazette, declare any computer resource which directly or indirectly affects the facility of Critical Information Infrastructure, to be a protected system.
Reason (R): Any person who secures access to a protected system in contravention of the IT Act shall be punished with imprisonment up to ten years and shall also be liable to fine.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

75. Arrange the procedural steps for blocking websites for public access under the Information Technology (Procedure and Safeguards for Blocking for Access of Information by Public) Rules, 2009:
1. Nodal officer forwards the complaint to the Designated Officer
2. Committee examines the request and gives the intermediary an opportunity to be heard
3. Designated Officer submits the Committee's recommendation to the Secretary, MeitY
4. Central Government issues the blocking order to the intermediary

Which of the following represents the correct sequence?
(A) 1, 2, 3, 4
(B) 2, 1, 3, 4
(C) 1, 3, 2, 4
(D) 2, 3, 1, 4

76. As per Section 67C of the Information Technology Act, 2000, intermediaries are mandated to preserve and retain such information as may be specified for such duration and in such manner and format as the Central Government may prescribe. Failure to do so is punishable with imprisonment up to:
(A) 1 year
(B) 2 years
(C) 3 years
(D) 5 years

77. The definition of "Intermediary" under Section 2(w) of the Information Technology Act, 2000 encompasses all of the following EXCEPT:
(A) An individual creator authoring a personal blog post on a self-hosted server
(B) Telecommunication service providers operating public transmission networks
(C) Network service providers and web hosting infrastructure operators
(D) Online-auction sites, internet payment gateways, and search engines

78. In digital forensics, when investigating an offence under Section 65 (tampering with computer source documents) of the Information Technology Act, 2000, the forensic expert will primarily analyse the:
(A) Browser navigation history and cached internet files on the suspect's computer
(B) Wi-Fi router traffic connection logs and network access point records
(C) File metadata and source code versions in the repository
(D) Deleted photographic images and media files recovered from storage drives

NQDIA

79. A person maliciously uses a keylogger to obtain the login credentials of a bank customer and subsequently transfers money to his own account. Under the Information Technology Act, 2000, this act of capturing credentials dishonestly falls under the definition of:
(A) Cyber terrorism under Section 66F
(B) Publishing obscene material under Section 67
(C) Breach of confidentiality under Section 72
(D) Identity theft under Section 66C

80. If an employee of an IT company steals proprietary data from their employer's servers without permission, the civil liability for paying compensation to the employer falls under which section of the Information Technology Act, 2000?
(A) Section 43
(B) Section 65
(C) Section 66E
(D) Section 70

81. Consider the following statements regarding the powers of investigation under the Information Technology Act, 2000:
I. No police officer below the rank of Inspector shall investigate any offence under this Act.
II. A police officer may enter and search

fine of Rs. 5 lakh.
IV. This section provides an exception for material published for the public good on the grounds of science, literature, or art.

Which combination of the above statements is correct?
(A) I, II and III only
(B) I, II and IV only
(C) II, III and IV only
(D) I, II, III and IV

38. While Section 67 of the Information Technology Act, 2000 deals with publishing "obscene" material, Section 67A deals with a higher degree of offence concerning the publishing or transmitting of material containing:
(A) Defamatory content against the State
(B) Copyright-infringing movies
(C) Stolen corporate source code
(D) Sexually explicit act or conduct

39. What is the maximum punishment for the first conviction under Section 67B of the Information Technology Act, 2000, which deals with publishing or transmitting material depicting children in sexually explicit acts (child pornography)?
(A) Imprisonment up to 3 years and fine up to Rs. 5 lakh
(B) Imprisonment up to 5 years and fine up to Rs. 10 lakh
(C) Imprisonment up to 7 years and fine up to Rs. 10 lakh
(D) Imprisonment up to 10 years and fine up to Rs. 20 lakh

40. Under Section 67B of the Information Technology Act, 2000 (Child Pornography), the term "child" is defined as any person who has not completed the age of:
(A) 14 years
(B) 16 years
(C) 18 years
(D) 21 years

41. Section 69 of the Information Technology Act, 2000 empowers the Central or State Government to intercept, monitor, or decrypt any information generated, transmitted, received or stored in any computer resource. Which of the following is NOT a valid statutory ground for invoking this power?
(A) In the interest of the sovereignty, integrity, or defense of India
(B) For the prevention of incitement or investigation of any cognizable offence
(C) In the interest of maintaining public order and security of the State
(D) To protect the commercial interests of a private corporation

42. Which section of the Information Technology Act, 2000 empowers the government to issue directions for blocking public access to any information through any computer resource (e.g., blocking websites or mobile applications)?
(A) Section 69A
(B) Section 69B
(C) Section 70
(D) Section 72

43. Section 69B of the Information Technology Act, 2000 grants the Central Government the power to authorize an agency to monitor and collect traffic data or information through any computer resource. The primary stated purpose of this section is:
(A) To collect and analyze statutory income tax data and financial records from corporate entities.
(B) To enhance cyber security and analyze, identify, and prevent computer contaminants in the country.
(C) To monitor and restrict unlawful copyright infringements taking place on peer-to-peer file networks.
(D) To continuously track and verify the physical location and movement of foreign tourists in India.

44. Under Section 70 of the Information Technology Act, 2000, who has the authority to declare any computer resource, the incapacitation or destruction of which shall have a debilitating impact on national security, economy, public health or safety, as a "Protected System"?
(A) The President of India acting on the advice of the Union Cabinet
(B) The Appropriate Government (Central or State Government)
(C) The Director General of Police of the concerned State
(D) The Controller of Certifying Authorities under MeitY

45. Any person who secures access or attempts to secure access to a "Protected System" in contravention of the provisions of Section 70 of the Information Technology Act, 2000 shall be

Click Here to Buy book on Amazon

device or management of activities.

(D) Only a senior gazetted forensic examiner attached to the State or Central Forensic Science Laboratory evidence division.

89. Which of the following best defines a "Denial of Service (DoS)" attack, which is a contravention under Section 43(f) of the Information Technology Act, 2000?

(A) Unauthorized extraction and theft of confidential password hashes or credential files from a server repository.

(B) Infecting a system with malicious ransomware programs and demanding cryptocurrency payments for decryption keys.

(C) Setting up an unauthorized rogue Wi-Fi access point or duplicate network to silently intercept user data traffic.

(D) Flooding a computer resource with requests to prevent authorized users from accessing it.

90. The Information Technology (Amendment) Act, 2008 added a provision to Section 81 stating that the provisions of the IT Act shall have an overriding effect. However, nothing in this Act restricts any person from exercising rights conferred under which specific legislation?

(A) The Copyright Act, 1957 or the Patents Act, 1970

(B) The Indian Contract Act, 1872 and its amendments

(C) The Right to Information Act, 2005 and rules thereunder

(D) The Indian Evidence Act, 1872 and statutory provisions

NODIA

37. (D) I, II, III and IV
Section 67 of the Information Technology Act, 2000 penalizes publishing or transmitting obscene material in electronic form. It covers lascivious content appealing to prurient interests that corrupts viewers. First conviction carries up to three years imprisonment and five lakh rupees fine. Statutory exemptions exist for material justified for the public good, science, literature, art, or learning.

38. (D) Sexually explicit act or conduct
While Section 67 addresses general obscenity in electronic form, Section 67A was inserted by the 2008 Amendment to penalize a more severe offence. Section 67A specifically targets the publishing, transmitting, or causing to be published in electronic form any material which contains sexually explicit acts or conduct, prescribing higher terms of imprisonment and financial fines.

39. (B) Imprisonment up to 5 years and fine up to Rs. 10 lakh
Section 67B of the Information Technology Act, 2000 addresses child pornography and online child abuse material. For a first conviction, the statute prescribes punishment of imprisonment of either description for a term extending up to five years and a fine extending up to ten lakh rupees, reflecting strict statutory deterrence against child exploitation in digital media.

40. (C) 18 years
For the purposes of Section 67B of the Information Technology Act, 2000, which penalizes the depiction of children in sexually explicit acts in electronic form, an explanation within the section defines a "child" as any person who has not completed eighteen years of age. This aligns with national standards for legal adulthood and child protection.

41. (D) To protect the commercial interests of a private corporation
Section 69 of the Information Technology Act, 2000 grants governmental power to intercept, monitor, or decrypt electronic information. Statutory grounds are strictly restricted to sovereignty, integrity, defense of India, security of the State, friendly relations with foreign states, public order, or investigating cognizable offences. Safeguards ensure this executive authority cannot be invoked for purely private commercial interests.

42. (A) Section 69A
Section 69A of the Information Technology Act, 2000 empowers the Central Government to issue directions to block public access to any information through any computer resource. Such directions are issued in the interest of national sovereignty, defense, state security, friendly foreign relations, or public order, subject to procedural safeguards specified in rules framed under the Act.

43. (B) To enhance cyber security and analyze, identify, and prevent computer contaminants in the country.
Section 69B of the Information Technology Act, 2000 authorizes the Central Government to monitor and collect traffic data through any computer resource. The explicitly stated statutory objective of this monitoring power is to enhance cyber security and to analyze, identify, and prevent computer contaminants or malicious threats within the nation's digital communications infrastructure.

44. (B) The Appropriate Government (Central or State Government)
Under Section 70(1) of the Information Technology Act, 2000, the Appropriate Government (Central or State Government) holds statutory authority to declare any computer resource a "Protected System" by notification in the Official Gazette. This designation applies to systems whose incapacitation or destruction would cause debilitating impacts on national security, economy, or public safety.

45. (D) 10 years
Section 70(2) of the Information Technology Act, 2000 restricts access to protected systems to authorized personnel only. Any person who secures access or attempts to secure access to a protected system in contravention of Section 70 commits a severe offence, punishable with imprisonment of either description for a term extending up to ten years, alongside fine liability.

46. (A) P-3, Q-1, R-4, S-2
Specific offences under the Information Technology Act correspond directly to designated legal sections. Dishonestly receiving a stolen computer resource is governed by Section 66B.

Downloaded from www.pdf.tube

9. (D) Originator
Section 2(1)(za) of the Information Technology Act, 2000 defines an originator as a person who sends, generates, stores, or transmits any electronic message, or causes it to be sent, generated, stored, or transmitted to any other person. However, the definition explicitly excludes an intermediary who merely acts as a conduit for storing or transmitting the message.

10. (B) Section 4
Section 4 of the Information Technology Act, 2000 accords legal recognition to electronic records. It lays down that where any law provides that information or any other matter shall be in writing or in the typewritten or printed form, such requirement is deemed satisfied if the information or matter is rendered or made available in an electronic form.

11. (B) Digital signatures rely on asymmetric cryptosystems and hash functions, whereas electronic signatures include other scheduled reliable techniques.
Under the Information Technology Act, 2000, a digital signature is a specific, technology-dependent method of authentication based on asymmetric cryptography and hash functions. In contrast, an electronic signature is a broader, technology-neutral legal concept that encompasses digital signatures as well as other reliable authentication techniques specified in the Second Schedule of the amended legislation.

12. (C) IV only
Under Section 3 of the Information Technology Act, 2000, electronic records are authenticated using asymmetric cryptosystems and hash functions. The subscriber holds a unique key pair consisting of a private key and a public key. Any recipient or verifier can easily verify the authenticity and integrity of the signed electronic record by utilizing the subscriber's publicly available public key.

13. (C) Section 5
Section 5 of the Information Technology Act, 2000 grants legal recognition to electronic signatures. It provides that where any law requires that information or a document must be authenticated by a person's physical signature, such requirement is considered satisfied if the individual authenticates the electronic record using a recognized electronic signature or digital signature technique.

14. (C) An unauthorized third party who intercepted the originator's transmission
Section 11 of the Information Technology Act, 2000 specifies that an electronic record is attributed to the originator if sent by the originator personally, by an authorized representative, or by an automated information system programmed by or on behalf of the originator. Transmission by an unauthorized third party who intercepts the record does not constitute legal attribution.

15. (D) When it enters a computer resource outside the control of the originator
According to Section 13(1) of the Information Technology Act, 2000, the dispatch of an electronic record occurs when it enters a computer resource outside the control of the originator, unless otherwise agreed. This statutory rule provides clear legal determination regarding the precise moment an electronic message or record is officially dispatched during digital communications.

16. (C) The prescribed security procedure has been applied to it from a specified point of time to verification.
Section 14 of the Information Technology Act, 2000 specifies that where a prescribed security procedure has been applied to an electronic record at a specific point in time, such record is deemed a secure electronic record from that point until verification. The Central Government designates such procedures to ensure data integrity and prevent unauthorized alteration.

17. (B) Section 17
Under Section 17 of the Information Technology Act, 2000, the Central Government is empowered to appoint the Controller of Certifying Authorities by notification in the Official Gazette. The Central Government may also appoint Deputy Controllers and Assistant Controllers as necessary to discharge administrative and regulatory duties connected with public key infrastructure and digital certificate oversight.

NODIA

18. (D) Issuing Digital Signature Certificates directly to individual citizens
The Controller of Certifying Authorities acts as the apex regulatory body supervising Certifying

ANSWERS

1. (B) UNCITRAL Model Law on Electronic Commerce, 1996
The Information Technology Act, 2000 was drafted to provide legal recognition for transactions carried out by means of electronic data interchange and other means of electronic communication. India adopted this legislation based on the Model Law on Electronic Commerce adopted by the United Nations Commission on International Trade Law in 1996 to facilitate international trade.

2. (D) It applies to any offence or contravention committed outside India by any person, provided the act involves a computer, computer system, or computer network located in India.
Section 1 read with Section 75 of the Information Technology Act, 2000 gives the statute extra-territorial jurisdiction. This means the legal framework applies to any person of any nationality committing an offence or contravention outside Indian territory, provided that the underlying act targets or involves a computer, computer system, or network physically located in India.

3. (B) Section 2(1)(i)
Under the Information Technology Act, 2000, Section 2(1)(i) explicitly defines a computer as any electronic, magnetic, optical, or other high-speed data processing device or system. It performs logical, arithmetic, or memory functions by manipulations of signals, including all input, output, processing, storage, software, or communication facilities connected or related to such a system.

4. (D) I, II and III
The Information Technology (Amendment) Act, 2008 introduced major structural changes to modernize cyber law. It established technological neutrality by introducing electronic signatures alongside digital signatures. It also inserted Section 66A to penalize offensive communication messages and provided a statutory footing under Section 70B for the establishment and operations of the Indian Computer Emergency Response Team.

5. (A) Computer system or computer network
Section 2(1)(o) of the Information Technology Act, 2000 defines data as a representation of information, knowledge, facts, concepts, or instructions. These representations are prepared in a formalized manner and are stored internally or externally in computer memory, or intended to be processed, or have been processed in a computer system or a computer network.

6. (D) Data, record, generated data, image or sound stored, received or sent in electronic form or microfiche.
Section 2(1)(t) of the Information Technology Act, 2000 offers a broad and comprehensive definition of an electronic record. It encompasses data, records, generated data, images, or sounds stored, received, or transmitted in electronic form, microfiche, or computer-generated micro-film. This broad scope ensures that various formats of digital information receive uniform legal recognition.

7. (B) A public key for encryption and a private key for decryption
Section 2(1)(f) of the Information Technology Act, 2000 defines an asymmetric crypto system as a system of a secure key pair consisting of a private key for creating a digital signature and a public key to verify the digital signature. The mathematical relationship ensures that messages encrypted with one key require the corresponding key.

8. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Digital signatures rely on an asymmetric cryptosystem alongside cryptographic hash functions to guarantee authenticity and integrity. A hash function transforms electronic data into a unique fixed-length value. Because even a slight modification in the original electronic record radically alters the resulting hash value, this mathematical process ensures that any unauthorized tampering with signed electronic records is immediately detected.

Click Here to Buy book on Flipkart

intentionally conceal, destroy, alter, or cause another to alter computer source code when that code is required to be kept or maintained by law for the time being in force.

28. (C) Imprisonment up to 3 years or fine up to Rs. 2 lakh, or both
Under Section 65 of the Information Technology Act, 2000, any person who knowingly or intentionally conceals, destroys, or alters computer source code required to be maintained by law commits a penal offence. The prescribed maximum punishment for this offence is imprisonment for a term extending up to three years, or a fine up to two lakh rupees, or both.

29. (D) Assertion (A) is false but Reason (R) is true.
The Information Technology (Amendment) Act, 2008 replaced the original title "Hacking with computer system" in Section 66 with "Computer related offences". Section 66 provides that if any person dishonestly or fraudulently commits any act listed under Section 43, it constitutes a criminal offence punishable with imprisonment up to three years or fine up to five lakh rupees, or both.

30. (A) I and II only
Section 43 of the Information Technology Act, 2000 governs civil liabilities, penalizing unauthorized acts with financial compensation. Section 66 converts these exact acts into criminal offences if committed dishonestly or fraudulently. Because civil remedy and criminal prosecution address distinct legal aspects, an offender can simultaneously face civil compensation proceedings under Section 43 and criminal prosecution under Section 66.

31. (C) 3 years
Section 66B of the Information Technology Act, 2000 penalizes the dishonest receipt or retention of stolen computer resources or communication devices. Any individual who dishonestly receives or retains such stolen property, knowing or having reason to believe it to be stolen, is punishable with imprisonment of either description for a term extending up to three years, or fine, or both.

32. (B) Section 66C
Section 66C of the Information Technology Act, 2000 explicitly penalizes identity theft. This section applies when a person fraudulently or dishonestly makes use of the electronic signature, password, or any other unique identification feature of another person. The prescribed penalty includes imprisonment of either description for a term up to three years and fine up to one lakh rupees.

33. (C) Section 66D (Cheating by personation by using computer resource)
Creating a fake profile representing another individual to deceive and fraudulently solicit funds constitutes cheating by personation. Under Section 66D of the Information Technology Act, 2000, whoever by means of any computer resource or communication device cheats by personation is punished with imprisonment of either description for a term which may extend to three years and fine.

34. (D) The naked or undergarment clad genitals, pubic area, buttocks, or female breast
Section 66E of the Information Technology Act, 2000 penalizes the intentional capture, publication, or transmission of images depicting a private area of any person without consent. The explanation to Section 66E explicitly defines "private area" as the naked or undergarment-clad genitals, pubic area, buttocks, or female breast, safeguarding personal privacy against unauthorized visual captures.

35. (D) I, II and III
Section 66F of the Information Technology Act, 2000 comprehensively defines cyber terrorism. It encompasses acts performed with intent to threaten the unity, integrity, security, or sovereignty of India. These include denying authorized access to computer resources, introducing computer contaminants causing death or injury, or illegally accessing restricted systems containing sensitive information affecting national security and sovereign relations.

36. (C) Imprisonment which may extend to imprisonment for life
Cyber terrorism is treated as one of the most severe offences under Indian cyber law due to its impact on national security, sovereignty, and public safety. Section 66F of the Information Technology Act, 2000 specifies that whoever commits or conspires to commit cyber terrorism shall be punishable with imprisonment which may extend to imprisonment for life.

Downloaded from www.pdf.tube

56. (C) I, III and IV only
Section 70B(4) of the Information Technology Act, 2000 outlines the statutory duties of CERT-In. These include collecting, analyzing, and disseminating information on cyber incidents, issuing cyber security advisories, taking emergency response measures, and coordinating incident response activities. Issuing Digital Signature Certificates to foreign nationals is handled by Certifying Authorities, not by CERT-In.

57. (D) Shreya Singhal v. Union of India
In the landmark 2015 judgment of Shreya Singhal v. Union of India, the Supreme Court of India invalidated Section 66A of the Information Technology Act, 2000. The Court held Section 66A unconstitutional, ruling that its vague and overbroad language disproportionately restricted freedom of speech and expression guaranteed under Article 19(1)(a) of the Constitution.

58. (B) Section 65A and 65B
The Information Technology Act, 2000 amended the Indian Evidence Act, 1872 by inserting Sections 65A and 65B. Section 65A provides that contents of electronic records may be proved in accordance with Section 65B. Section 65B details specific conditions and certification requirements governing the admissibility of electronic evidence in judicial proceedings.

59. (C) Section 63
With the enactment of the Bharatiya Sakshya Adhiniyam, 2023 replacing the Indian Evidence Act, 1872, statutory legal provisions regarding electronic evidence were restructured. Section 63 of the Bharatiya Sakshya Adhiniyam, 2023 directly corresponds to the erstwhile Section 65B of the Indian Evidence Act, establishing procedural rules and certification requirements for electronic record admissibility.

60. (D) Section 65B(4)
Under the erstwhile Indian Evidence Act, 1872, Section 65B(4) required a certificate to accompany secondary evidence of electronic records. This certificate identifies the electronic record, describes the device involved, gives details of management conditions, and must be signed by a person occupying a responsible official position in relation to the operation of the device.

NODIA

61. (A) Anwar P.V. v. P.K. Basheer
In the 2014 landmark ruling of Anwar P.V. v. P.K. Basheer, a three-judge Bench of the Supreme Court overruled the previous precedent in Navjot Sandhu. The Court established that producing a certificate under Section 65B(4) of the Indian Evidence Act, 1872 is a mandatory statutory pre-condition for introducing secondary evidence of an electronic record.

62. (C) The certificate is not required if the original device (primary evidence) itself is produced in court.
In Arjun Panditrao Khotkar v. Kailash Kushanrao Gorantyal (2020), the Supreme Court clarified that Section 65B of the Evidence Act applies strictly to secondary electronic evidence. When the original computer, server, or recording device itself is brought directly into court as primary evidence, the submission of a Section 65B certificate becomes unnecessary.

63. (B) II and III only
In Sharat Babu Digumarti v. Govt of NCT of Delhi, the Supreme Court ruled that where an offence involves electronic records, special provisions of the IT Act override general penal statutes. Under Section 81 of the IT Act, its provisions possess overriding effect, preventing dual prosecution under general laws for identical facts.

64. (C) FIR is registered under both the IT Act and relevant general penal sections to cover all facets of the crime, subject to judicial framing of charges.
When a crime involves electronic manipulation along with traditional criminal elements, investigating officers routinely register the FIR under relevant sections of both the Information Technology Act and general penal laws. This initial registration captures all dimensions of criminal conduct, leaving the ultimate evaluation of overriding statutory provisions to judicial framing of charges.

65. (A) P-1, Q-4, R-1, S-2
Statutory penalties under the Information Technology Act vary according to severity. Tampering with source documents (Section 65) carries up to three years imprisonment. Cyber terrorism (Section 66F) carries up to life imprisonment. Publishing obscene content (Section 67) carries three years for first

Identity theft falls under Section 66C. Cheating by personation using a computer resource is penalized under Section 66D, while violation of personal privacy by capturing private images is covered by Section 66E.

47. (D) Any person who, under powers conferred by the Act, secures access to an electronic record and discloses it without consent.
Section 72 of the Information Technology Act, 2000 addresses breach of confidentiality and privacy. It specifically applies to any person who, exercising powers conferred under the Act, rules, or regulations, gains access to an electronic record, book, register, or correspondence, and discloses such material to another person without obtaining consent from the affected party.

48. (C) Persons who disclose personal information obtained under a lawful contract with intent to cause wrongful loss or gain.
Section 72A of the Information Technology Act, 2000 penalizes disclosure of information in breach of lawful contract. It applies to any service provider or person who, while providing services under a lawful contract, secures access to personal information and discloses it without consent, intending or knowing it is likely to cause wrongful loss or wrongful gain.

49. (D) Assertion (A) is false but Reason (R) is true.
Section 79 of the Information Technology Act, 2000 provides conditional immunity, known as safe harbour, to intermediaries for third-party content. Immunity is not absolute; it requires the intermediary to observe statutory due diligence and remain neutral. If the intermediary abets, conspires, or fails to expeditiously remove unlawful content upon receiving actual knowledge, safe harbour protection is lost.

50. (D) The intermediary conspired or abetted in the commission of the unlawful act.
Under Section 79(3) of the Information Technology Act, 2000, safe harbour protection is explicitly revoked if the intermediary conspired, abetted, aided, or induced the commission of the unlawful act. Safe harbour also ceases if an intermediary fails to promptly remove or disable access to illegal material upon receiving actual knowledge or official notification from competent authorities.

51. (A) Director to the Government of India or an equivalent officer of a State Government
Section 46 of the Information Technology Act, 2000 provides for the appointment of Adjudicating Officers to hold inquiries regarding civil contraventions. To ensure competent administrative adjudication, the statute mandates that the appointed Adjudicating Officer must possess field experience and qualifications equivalent to a Director to the Government of India or an equivalent State Government officer.

52. (B) Adjudicating Officer → Cyber Appellate Tribunal (TDSAT) → High Court → Supreme Court
Civil contraventions under the Information Technology Act, 2000 follow a structured statutory appellate hierarchy. Matters originate before the Adjudicating Officer. Appeals against these adjudicatory decisions lie to the Cyber Appellate Tribunal (functions merged with TDSAT). Appeals from tribunal decisions proceed directly to the High Court on questions of law, and subsequently to the Supreme Court.

53. (A) Inspector of Police
Section 78 of the Information Technology Act, 2000 specifies the minimum rank required to conduct investigations under the Act. Originally setting the threshold at Deputy Superintendent of Police, the 2008 Amendment lowered the rank, empowering any police officer not below the rank of Inspector of Police to investigate offences committed under the statutory provisions.

54. (D) Cognizable and bailable
Section 77B of the Information Technology Act, 2000 regulates the classification of offences. It explicitly lays down that, notwithstanding anything contained in the Code of Criminal Procedure, 1973, all offences punishable under the Act with imprisonment of three years and above are classified as cognizable and bailable, except for specifically excluded severe offences.

55. (B) Indian Computer Emergency Response Team
Section 70B of the Information Technology Act, 2000 provisions the establishment of CERT-In, which stands for the Indian Computer Emergency Response Team. Operating under the Ministry of Electronics and Information Technology, CERT-In serves as the national nodal agency for responding to computer security incidents and securing Indian cyberspace infrastructure.

Click Here to Buy book on Amazon

75. (A) 1, 2, 3, 4
The procedural workflow under the 2009 Blocking Rules follows a strict sequential process. First, the designated Nodal Officer receives and forwards complaints to the Designated Officer. Next, an examination committee evaluates requests and hears the affected intermediary. The Designated Officer then submits recommendations to the Secretary, MeitY, who subsequently issues formal blocking orders.

76. (C) 3 years
Section 67C of the Information Technology Act, 2000 mandates that intermediaries must retain and preserve specified information for durations and formats prescribed by the Central Government. An intermediary who intentionally or knowingly fails to preserve and retain such electronic data in compliance with prescribed rules faces punishment extending up to three years imprisonment.

77. (A) An individual creator authoring a personal blog post on a self-hosted server
Section 2(w) of the Information Technology Act, 2000 defines an intermediary as any entity that receives, stores, or transmits electronic records on behalf of another person. It includes network service providers, telecom operators, web hosts, and search engines. An individual authoring and publishing personal content on a self-hosted platform acts as an originator, not an intermediary.

78. (C) File metadata and source code versions in the repository
In digital forensic investigations concerning Section 65 of the Information Technology Act, 2000, the offense centers on unauthorized tampering with computer source code. Forensic examiners focus analysis on file metadata, code structure, modification timestamps, and version histories within software repositories to identify unauthorized alterations, deletions, or concealments of source documents.

79. (D) Identity theft under Section 66C
Using malware such as keyloggers to surreptitiously capture another person's login credentials or online banking passwords constitutes identity theft. Under Section 66C of the Information Technology Act, 2000, dishonestly or fraudulently making use of the password or unique identification feature of any other person is penalised with imprisonment and fine.

80. (A) Section 43
Section 43 of the Information Technology Act, 2000 addresses civil liabilities for computer system contraventions. If an employee extracts, downloads, or copies proprietary data or computer source code from an employer's network without authority, Section 43 obligates the wrongdoer to pay compensation by way of damages to the affected enterprise or owner.

81. (A) I and II only
Under Section 78 of the Information Technology Act, 2000, cybercrime investigations must be conducted by a police officer not below the rank of Inspector. Section 80 authorizes Inspectors to enter public places and search or arrest without warrant upon reasonable suspicion. However, not all offences are non-bailable; Section 77B classifies most offences as bailable.

NODIA

82. (B) 3, 2, 4, 1
Processing seized mobile evidence follows standard digital forensic protocols. First, the examiner conducts physical examination and documentation of the device. Second, the mobile phone is isolated in a Faraday bag to prevent remote wiping over cellular networks. Third, forensic tools extract logical or physical data. Finally, cryptographic hash values are generated to verify data integrity.

83. (A) P-2, Q-1, R-3, S-4
Statutory definitions under the Information Technology Act establish clear legal meanings. A cyber cafe is a commercial facility offering internet access to the public. A computer contaminant is a set of instructions designed to modify or destroy data. The Electronic Gazette refers to official gazettes published electronically, and a key pair comprises asymmetric private and public keys.

84. (C) Forgery of electronic record
The Information Technology Act, 2000 amended Section 463 and Section 464 of the Indian Penal Code to incorporate digital dimensions into traditional forgery law. This statutory modification created the criminal offence of making a false electronic record, extending penal provisions regarding forgery and fraudulent

conviction, while publishing sexually explicit material (Section 67A) carries five years.

66. (D) Both (A) and (C) are part of the statutory definition.
Section 2(1)(j) of the Information Technology Act, 2000 defines a computer network. The statutory definition encompasses the physical interconnection of two or more computers through communication lines, as well as interconnections achieved through satellite, microwave, terrestrial lines, or other communication media, covering both physical and wireless networking infrastructure comprehensively.

67. (A) Secure Electronic Record Procedure
Under the Information Technology Act, 2000, a secure electronic record procedure refers to the statutory or prescribed security verification method applied to an electronic record. This procedure verifies that the record has remained uncorrupted, authentic, and completely unaltered from a specific point in time through to the time of verification.

68. (C) Any police officer not below the rank of Inspector
Section 80 of the Information Technology Act, 2000 confers special powers of search and arrest in public places. Any police officer not below the rank of Inspector is empowered to enter public places, search, and arrest without warrant any person reasonably suspected of committing or being about to commit any offence under the Act.

69. (A) Random Access Memory (RAM)
Volatile data refers to temporary digital information that is lost when power to a computer resource is terminated. In digital forensics, volatile data includes running processes, active network connections, and unallocated system cache. This dynamic information resides primarily in Random Access Memory, requiring immediate preservation before powering down or pulling system power plugs.

70. (D) Establish the chain of custody and prove the integrity of the data has not been altered since seizure.
A cryptographic hash value acts as a unique digital fingerprint for seized computer storage media. By calculating and documenting hash values at seizure and comparing them during subsequent forensic analysis, examiners prove that digital evidence remained pristine and unaltered, thereby establishing evidence integrity and supporting the legal chain of custody in court.

71. (B) National Technical Research Organisation (NTRO)
Section 70A of the Information Technology Act, 2000 authorizes the designation of the National Critical Information Infrastructure Protection Centre as the national nodal agency for protecting critical information infrastructure. NCIIPC functions under the administrative umbrella of the National Technical Research Organisation, overseeing strategic security policies for national critical sectors.

72. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
The Information Technology Act, 2000 features extra-territorial application. As stated in Section 75, the provisions apply to any offence or contravention committed outside India by any individual, regardless of nationality, provided that the underlying act targets or involves a computer, computer system, or computer network located physically within Indian territorial jurisdiction.

73. (A) I, II and III only
Section 69A of the Information Technology Act, 2000 specifies narrow grounds under which the Central Government can order website or content blocking. These grounds are sovereignty and integrity of India, defense of India, security of the State, friendly relations with foreign states, public order, or preventing incitement to cognizable offences. Private corporate defamation is excluded.

74. (B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
Under Section 70 of the Information Technology Act, 2000, the appropriate government can declare any computer resource affecting Critical Information Infrastructure as a protected system. Section 70(2) lays down that unauthorized access to such protected systems is punishable with imprisonment up to ten years and fine. Both legal statements are accurate independently.

Downloaded from www.pdf.tube

Authorities, laying down operating standards, and resolving operational conflicts under Section 18 of the IT Act. However, the Controller does not issue Digital Signature Certificates directly to end users; that function is exclusively handled by licensed public or private Certifying Authorities.

19. (B) 3 years
Under the regulatory framework managed by the Controller of Certifying Authorities in India, Digital Signature Certificates are granted for specified validity periods to maintain security standards. Licensed Certifying Authorities issue digital certificates to applicants for maximum operational validity periods of up to three years, after which identity verification and certificate renewal procedures must be re-conducted.

20. (A) 2, 1, 3, 4
Obtaining and utilizing a Digital Signature Certificate involves a logical sequence. First, an applicant submits an application with identity proof to a licensed Certifying Authority. Next, the cryptographic key pair is generated. The Certifying Authority then issues the certificate linking the public key to the applicant. Finally, the subscriber uses the private key to sign electronic records.

21. (A) Controller of Certifying Authorities (CCA)
Section 21 of the Information Technology Act, 2000 designates the Controller of Certifying Authorities as the statutory authority responsible for issuing, renewing, suspending, or revoking licenses to Certifying Authorities. Any entity seeking to act as a Certifying Authority to issue Electronic or Digital Signature Certificates must fulfill prescribed requirements and obtain approval from the Controller.

22. (A) P-4, Q-2, R-1, S-3
Under the Information Technology Act framework, statutory entities perform distinct statutory roles. The Controller of Certifying Authorities maintains the National Repository of Digital Certificates. Certifying Authorities issue Digital Signature Certificates to users. Subscribers generate key pairs and execute signatures, while intermediaries store, receive, or transmit electronic records on behalf of third-party users.

NODIA

23. (B) The Subscriber
Section 40 of the Information Technology Act, 2000 mandates that every subscriber must exercise reasonable care to retain control of the private key corresponding to the public key listed in their Digital Signature Certificate. If the private key is compromised, the subscriber remains legally bound to inform the Certifying Authority immediately to prevent unauthorized usage.

24. (C) Liability to pay damages by way of compensation to the person so affected by the contravention
Section 43 of the Information Technology Act, 2000 establishes civil liability for various unauthorized acts, such as accessing, downloading data, or introducing computer contaminants into a computer system. The offender is liable to pay damages by way of compensation to the affected party, as determined through adjudication by the appointed Adjudicating Officer.

25. (D) Body corporates possessing, dealing, or handling sensitive personal data or information
Section 43A of the Information Technology Act, 2000 addresses data protection obligations specifically for corporate entities. It lays down that where a body corporate possesses, deals with, or handles sensitive personal data or information in a computer resource, and is negligent in implementing reasonable security practices, it is liable to pay compensation to affected individuals.

26. (A) Information publicly available or accessible under the Right to Information Act, 2005
Under the Information Technology (Reasonable Security Practices and Procedures and Sensitive Personal Data or Information) Rules, 2011, sensitive personal data includes passwords, financial details, health conditions, and biometric data. However, information that is freely available or accessible in the public domain or furnished under the Right to Information Act, 2005 is explicitly excluded from this classification.

27. (B) The computer source code must be required to be kept or maintained by law for the time being in force.
Section 65 of the Information Technology Act, 2000 targets the offence of tampering with computer source documents. For this statutory section to apply, the person must knowingly or

document creation to cover digital and electronic records.

85. (C) 2013
The National Cyber Security Policy of India was officially released in 2013 by the Government of India. Designed to build a secure cyberspace ecosystem, the policy outlines comprehensive strategic framework measures to protect physical and operational critical national infrastructure, enhance cyber security capabilities, reduce vulnerabilities, and build effective threat response mechanisms across the country.

86. (A) Section 71
Section 71 of the Information Technology Act, 2000 penalizes misrepresentation. Any person who makes a false statement or suppresses a material fact when applying to the Controller or Certifying Authority for a license or Digital Signature Certificate faces punishment of imprisonment extending up to two years, or fine up to one lakh rupees, or both.

87. (C) Section 73
Section 73 of the Information Technology Act, 2000 penalizes publishing false Digital Signature Certificates. Whoever publishes or makes available a certificate knowing that it was not issued by the named Certifying Authority, or that the subscriber listed has not accepted it, or that it has been revoked, is punishable with imprisonment up to two years or fine.

88. (C) A person occupying a responsible official position in relation to the operation of the device or management of activities.
Both Section 65B(4) of the Indian Evidence Act, 1872 and Section 63(4) of the Bharatiya Sakshya Adhiniyam, 2023 specify who must sign the evidence certificate. The certificate must be signed by a person occupying a responsible official position in relation to the operation of the relevant device or the management of the relevant activity.

89. (D) Flooding a computer resource with requests to prevent authorized users from accessing it.
Section 43(f) of the Information Technology Act, 2000 covers acts that deny or cause the denial of access to an authorized user of a computer resource. A Denial of Service attack involves intentionally flooding target servers or network systems with excessive traffic requests, thereby overwhelming operational capacity and preventing legitimate authorized users from accessing the network services.

90. (A) The Copyright Act, 1957 or the Patents Act, 1970
Section 81 of the Information Technology Act, 2000 grants its provisions overriding effect over inconsistent laws. However, a specific proviso added by the 2008 Amendment clarifies that nothing contained in the Act restricts any person from exercising rights conferred under the Copyright Act, 1957 or the Patents Act, 1970, preserving statutory intellectual property protections.

www.nodia.in

Click Here to Buy book on Flipkart

Visit :
www.pdf.tube

Download PDFs For :

- ✓ MPPSC Chapterwise Question Bank
- ✓ KVS/NVS Chapterwise Question Bank
- ✓ KVS/NVS 30 Sample Papers for Tier-II
- ✓ DSSSB TGT Chapterwise Question Bank
- ✓ DSSSB Sample Papers
- ✓ Chapterwise Question Bank
- ✓ JEE NEET Foundation
- ✓ Primary Classes Worksheets
- ✓ Olympiad Guide
- ✓ Sample Papers
- ✓ Previous Year CBSE Papers
- ✓ Previous JEE, NEET and CUET Papers

Nodia Editions LLP
125, Sector 6, Vidhyadhar Nagar, Jaipur 302039

MRP ₹ 730.00